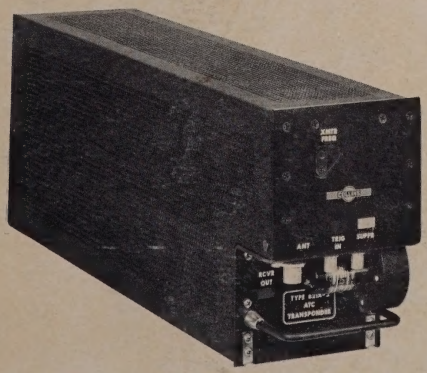
ATC
TRANSPONDER

621A-2

MAINTENANCE MANUAL



COLLINS RADIO COMPANY

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(D) Collins' type number, name, and serial number of principal equipment
(E) Unit sub-assembly number (where applicable)

MAINTENANCE MANUAL

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1 AUGUST 1959
5th REVISION, 1 JUNE 1961

ATC TRANSPONDER

621A-2

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MAINTENANCE MANUAL

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ATC TRANSPONDER

621A-2

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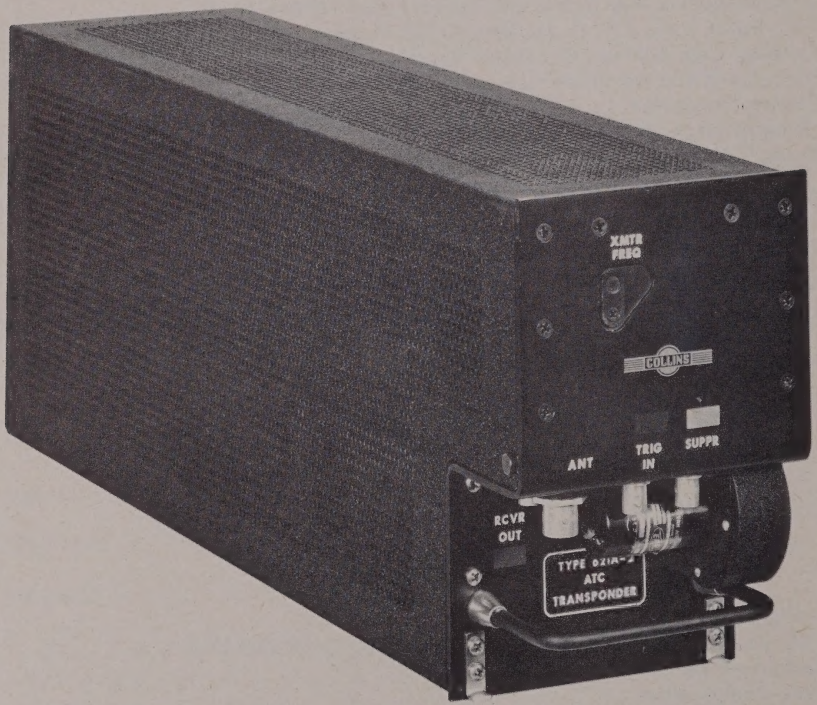


ATC Transponder 621A-2, Over-all View
Figure 1a

ATC TRANSPONDER 621A-2 - DESCRIPTION AND OPERATION

1. GENERAL.

This manual provides information which is required to maintain ATC Transponder 621A-2.

2. PURPOSE OF EQUIPMENT.

ATC Transponder 621A-2 is an airborne receiver-transmitter which receives an interrogating signal from a ground station transmitter and, in return, transmits a coded pulse-train reply signal. The unit is designed to meet the requirements of ARINC Air Traffic Control Transponder Characteristic 532B issued 2 December 1957.

3. PHYSICAL CHARACTERISTICS OF EQUIPMENT.

ATC Transponder 621A-2 is housed in JAN A1-d (1/2 ATR) case with over-all dimensions (including the front extension unit) of 22-1/16 inches long by 7-5/8 inches high by 4-7/8 inches wide. See figure 1a. The 621A-2 weighs 27.9 pounds.

Electrical connections to the 621A-2 are made at the rear of the unit through a Cannon DPD-45-34P-1C plug which mates with a DPD-45-33S-1 jack on the required associated shockmount (see figure 1b) or radio rack. Three type-BNC coaxial connectors and one type-C coaxial connector are located on the front panel of the 621A-2.

The chassis-panel assembly of the 621A-2 forms the mounting base for six modular-type plug-in subassemblies. Each module is constructed with a plug-in connector and a locating keying pin on the module base. The locating key pin prevents the module from being attached to the chassis in the incorrect location. Test points are provided on each module for the examination of significant circuit voltages and waveforms. The subassemblies (modules) of the 621A-2 are as follows.

A. R-F Module.

The r-f module contains all the transmitting and receiving circuits of the 621A-2.

B. Decoder Module.

The decoder module contains the circuits which recognize and accept an interrogation signal with desired characteristics and the circuits which reject those interrogation signals which do not have the desired characteristics. The module contains the mode selection circuits which determine the time spacing of the pulses of the interrogation signal which will be accepted. These mode selection circuits are linked to the control unit so that the pilot may select the desired mode of operation. The decoder initiates the reply signal when a proper interrogation signal is accepted.

Shockmount for the 621A-2, Over-all View
Figure 1b

C. Encoder Gate Module.

The encoder gate produces the gating signals which are used to select the desired number of pulses which will be present in the reply signals. Circuits which produce these gating signals are linked to the control unit so the pilot may select the desired reply signal.

D. Encoder Module.

The encoder module contains circuits which produce the coded reply signal.

E. Modulator Module.

The modulator module includes the high-voltage power supply and modulator system for producing the high-voltage pulses which are applied to the transmitter oscillator.

F. Chassis-Panel Assembly.

The chassis-panel assembly contains mating connectors for the modules, an interconnecting cable, and a rear connector to complete wiring to the external units. The front panel contains four connectors: the antenna (ANT), the transmitter-trigger (TRIG IN), the receiver output (RCVR OUT), and the external suppression (SUPPR). The chassis also serves as a plenum chamber in the directed-flow air-cooling system used in the 621A-2. The rear connector contains wiring for the code wires, primary power wires, and the on-standby controls.

The chassis assembly may also contain an optional visual monitor circuit. Components for this circuit, Collins part number 544 9365 004, are available from the manufacturer or may be installed as a custom modification at the factory. The visual monitor circuit will supply 27.5 volts d-c to pin 34 on the rear plug of the 621A-2 when the unit is being interrogated by one or more ground interrogators with a minimum interrogation rate of 175 per second.

An audio monitor circuit may be installed in ATC Transponder 621A-2. This circuit supplies 50 milliwatts across 500 ohms to pin 35 of the rear connector of the 621A-2. Components for the circuit, Collins part number 546 3534 003, are available from the manufacturer or may be installed as a custom modification at the factory.

4. THE COMPLETE SYSTEM.

The complete installation of an ATC Transponder 621A-2 includes a control unit, antenna, power supplies, and various interconnecting cables in addition to the 621A-2. A summary of the equipment required but not supplied is given in table 1. Figure 1b is an illustration of the shockmount.

TABLE 1. EQUIPMENT REQUIRED BUT NOT SUPPLIED

COMPONENT		CHARACTERISTICS
NAME	TYPE	
Antenna	AS-133/APX or equivalent (Collins part no. 013 1078 00)	
Control unit	(Collins part no. 097 5496 00)	Code selector for ATC Transponder 621A-2
Power supply		A-c input 115 volts, 300-1000 cps

TABLE 1. EQUIPMENT REQUIRED BUT NOT SUPPLIED (Cont)

COMPONENT		CHARACTERISTICS
NAME	TYPE	
Power supply		D-c input 27.5 volts d-c, 0.3 amp
R-f antenna cable	RG-8/U	RG-8/U or equivalent
TRIG IN, RCVR OUT, and SUPPR cables	RG-58/U	RG-58/U or equivalent
R-f antenna cable connector	UG-573A/U	Collins part number 357 0008 00
TRIG IN, RCVR OUT, and SUPPR connectors	UG-88/U	Collins part number 357 9292 00

A. Control Unit.

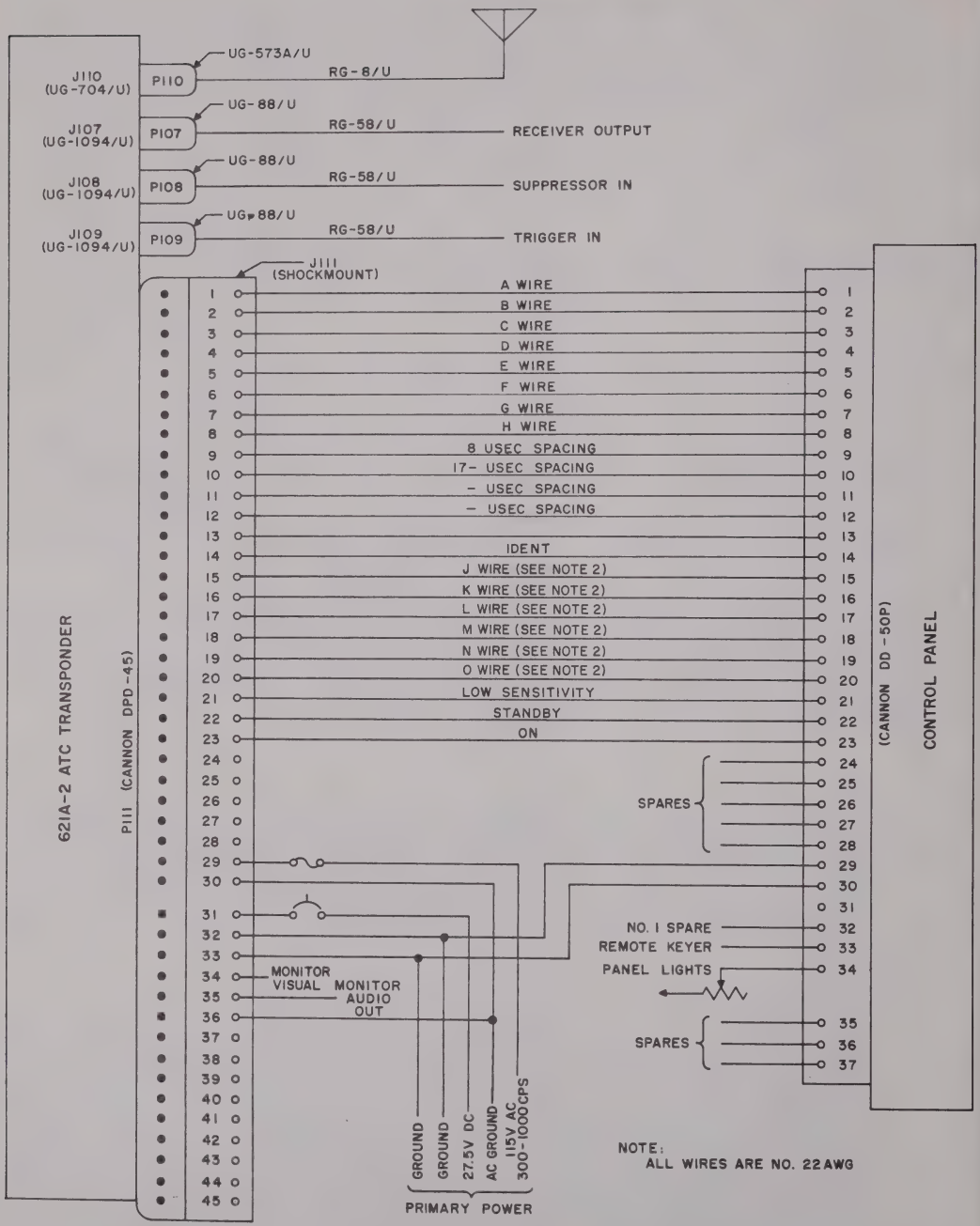
The control unit is located convenient to the pilot and provides the controls, selectors, and switches to operate the 621A-2. The control unit interconnects with the rear connector of the 621A-2 as shown in figures 2, 3, and 4. The control unit to be used depends upon the type of installation. The various types of control units and types of installation are discussed in the Installation Manual. The controls and selectors of this unit are as follows. Figure 5 is a front panel view of a typical control unit.

(1) Function Switch.

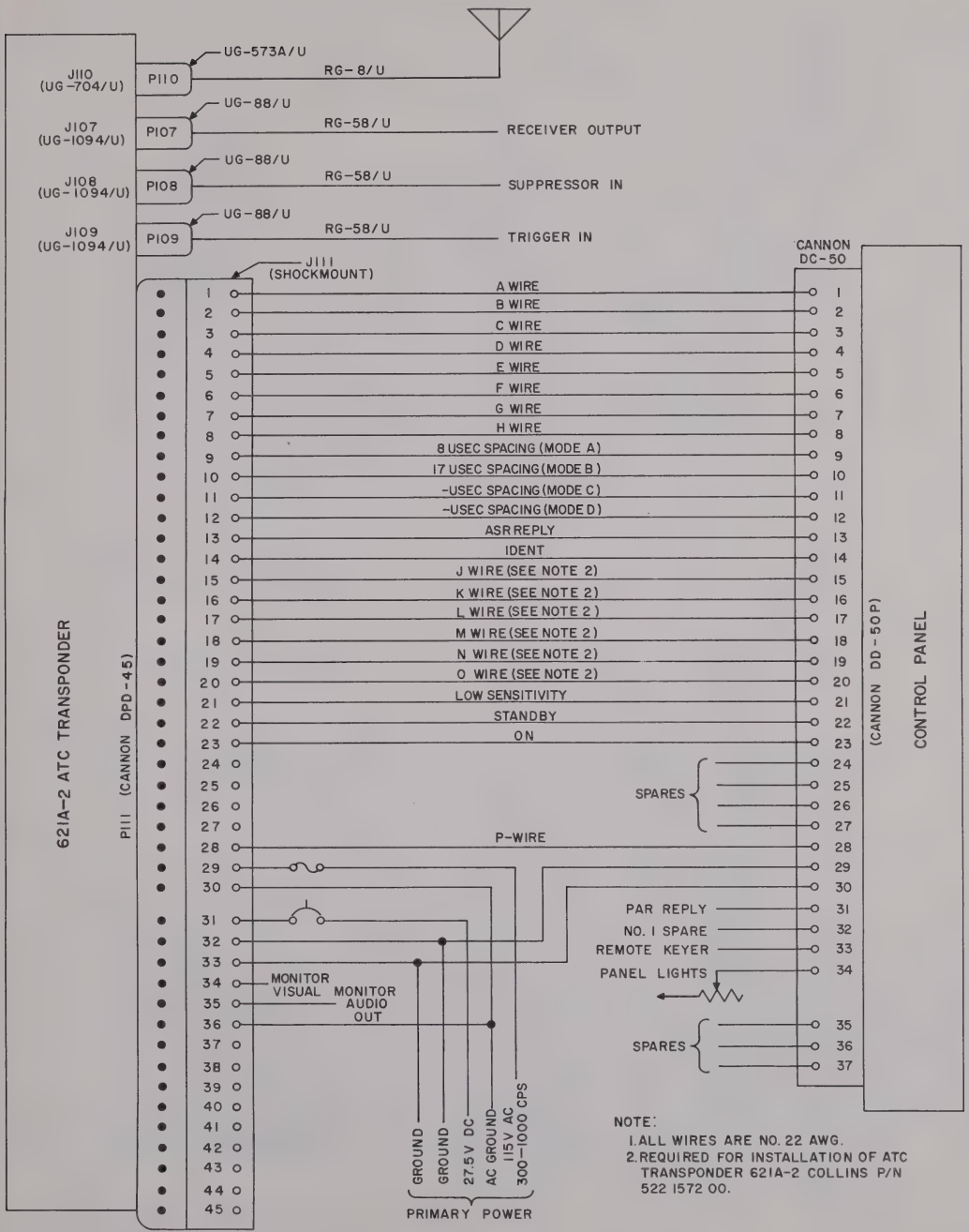
The function switch has four positions: OFF, STBY, ON, and LO SENS. The 621A-2 may be turned to standby (STBY) and left, and at any time after approximately 80 seconds can be turned to ON or low sensitivity (LO SENS) with immediate operation; or, the 621A-2 may be turned to ON or LO SENS immediately and, approximately 80 seconds later, voltage is applied to the circuits of the 621A-2. The LO SENS position reduces the gain of the i-f amplifier section of the 621A-2.

(2) Code Selector Switch.

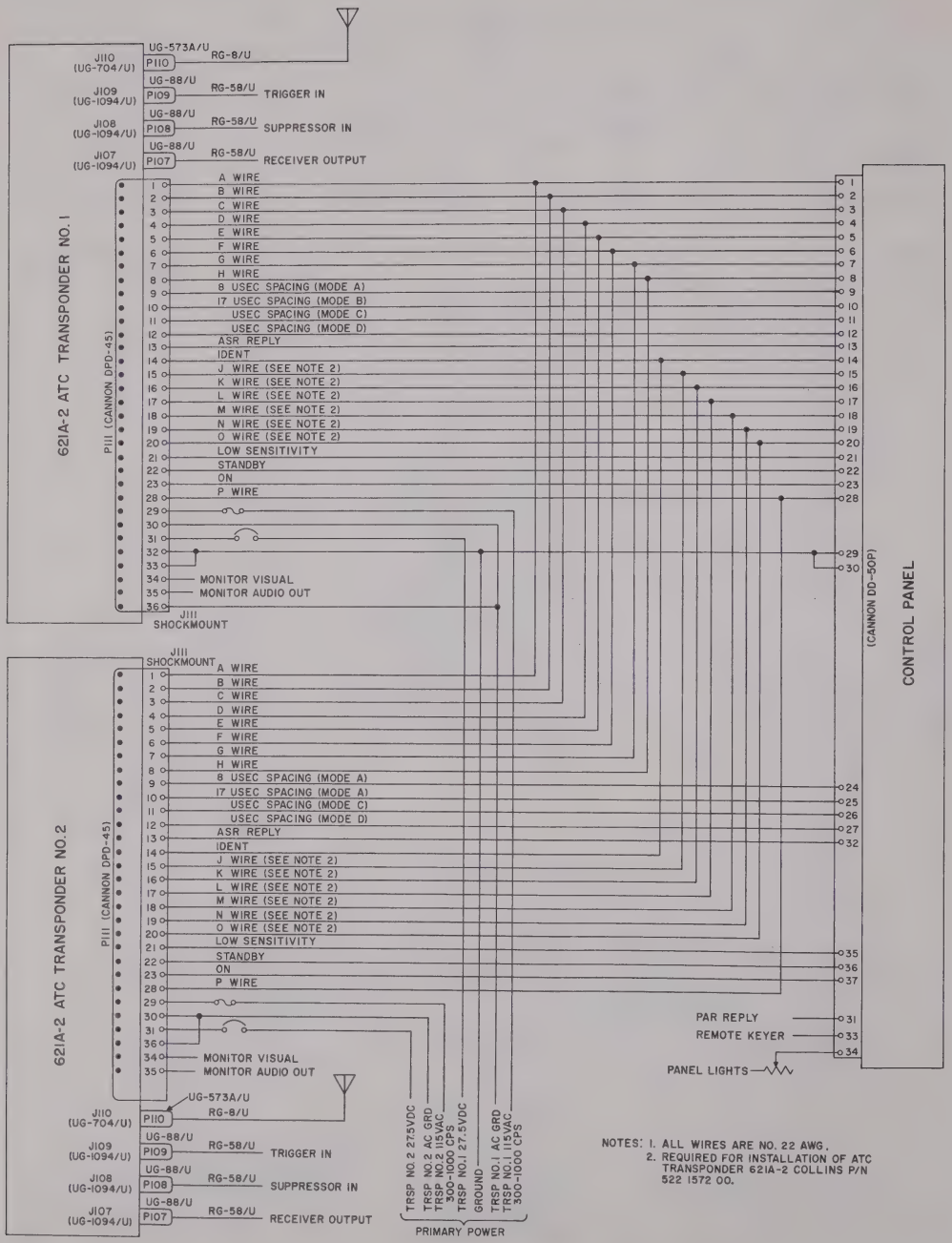
The settings of the dials of the control unit determine the selected reply code. The units and dials associated with the code selector read the code group number directly. Table 2 presents the code assignment for the code control unit. Figure 6 shows the designation code pulses for ATC Transponder 621A-2, Collins part number 522 1571 00. F_1 and F_2 refer to the framing pulses. A_1 through B_4 are information pulses with 2.9-microsecond spacing. Code 62, for example, would consist of pulses F_1 and F_2 (which are always present) and information pulses A_2, A_4, and B_2. SPI is the indentification pulses. The location of the various pulses in the pulse band is shown in figure 6. Figure 7 shows the designation of the pulses which will be obtained from ATC Transponder 621A-2, Collins part number 522 1572 00. The pulse spacing and locations are as shown in figure 7. Additional code assignment numbers which may be handled by ATC 621A-2, Collins part number 522 1572 00, have not been assigned.



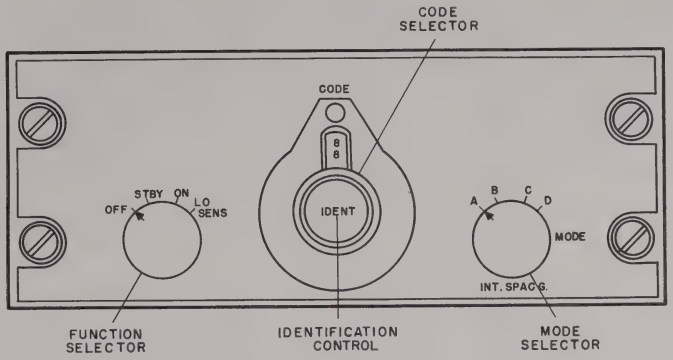
Installation Drawing, Single ATC Transponder 621A-2
Figure 2



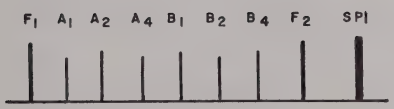
Installation Drawing, Single ATC Transponder 621A-2 with PAR and ASR Controls
Figure 3



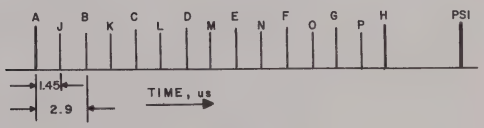
Installation Drawing, Dual ATC Transponder 621A-2
Figure 4



Typical Control Unit, ATC Transponder 621A-2
Figure 5



Pulse Designation for ATC Transponder 621A-2, P/N 522 1571 00
Figure 6



Pulse Designation for ATC Transponder 621A-2, P/N 522 1572 00
Figure 7

(3) Mode Selector Switch.

The mode selector switch also is known as the interval spacing (INT. SPACG.) selector. The switch determines the time spacing between interrogation pulses which will be accepted by the 621A-2. ATC Transponder 621A-2, Collins part number 522 1571 00, has two modes of operation: mode A, with 8-microsecond spacing between the interrogation pulses, and mode B, with 17-microsecond spacing between the interrogation pulses. ATC Transponder 621A-2, part number 522 1572 00, has provisions for four modes of operations: modes A and B as above and modes C and D. Modes C and D will have code spacing of either 19, 21, 23, or 25 microseconds. Modes C and D have not been assigned. Figure 8 shows the interrogating signal.

(4) Identification Control.

The IDENT control, when punched momentarily by the pilot, causes identification pulses to be transmitted with each reply group for a preset length of time.

TABLE 2. ATC RADAR BEACON SYSTEM REPLY CODE ASSIGNMENT NUMBERS

CODE NO.	INFORMATION PULSES PRESENT	CODE NO.	INFORMATION PULSES PRESENT	CODE NO.	INFORMATION PULSES PRESENT
00	None	26	$A_2B_2B_4$	53	$A_1A_4B_1B_2$
01	B_1	27	$A_2B_1B_2B_4$	54	$A_1A_4B_4$
02	B_2	30	A_1A_2	55	$A_1A_4B_1B_4$
03	B_1B_2	31	$A_1A_2B_1$	56	$A_1A_4B_2B_4$
04	B_4	32	$A_1A_2B_2$	57	$A_1A_4B_1B_2B_4$
05	B_1B_4	33	$A_1A_2B_1B_2$	60	A_2A_4
06	B_2B_4	34	$A_1A_2B_4$	61	$A_2A_4B_1$
07	$B_1B_2B_4$	35	$A_1A_2B_1B_4$	62	$A_2A_4B_2$
10	A_1	36	$A_1A_2B_2B_4$	63	$A_2A_4B_1B_2$
11	A_1B_1	37	$A_1A_2B_1B_2B_4$	64	$A_2A_4B_4$
12	A_1B_2	40	A_4	65	$A_2A_4B_1B_4$
13	$A_1B_1B_2$	41	A_4B_1	66	$A_2A_4B_2B_4$
14	A_1B_4	42	A_4B_2	67	$A_2A_4B_1B_2B_4$
15	$A_1B_1B_4$	43	$A_4B_1B_2$	70	$A_1A_2A_4$
16	$A_1B_2B_4$	44	A_4B_4	71	$A_1A_2A_4B_1$
17	$A_1B_1B_2B_4$	45	$A_4B_1B_4$	72	$A_1A_2A_4B_2$
20	A_2	46	$A_4B_2B_4$	73	$A_1A_2A_4B_1B_2$
21	A_2B_1	47	$A_4B_1B_2B_4$	74	$A_1A_2A_4B_4$
22	A_2B_2	50	A_1A_4	75	$A_1A_2A_4B_1B_4$
23	$A_2B_1B_2$	51	$A_1A_4B_1$	76	$A_1A_2A_4B_2B_4$
24	A_2B_4	52	$A_1A_4B_2$	77	$A_1A_2A_4B_1B_2B_4$
25	$A_2B_1B_4$				

B. Shockmount.

The shockmount for the 621A-2 provides a mounting base for the 621A-2. The shockmount, Collins part number 522 0569 004, has over-all dimensions of 23-3/4 by 5-7/8 by 2-7/8 inches. The unit weighs 2.1 pounds. See figure 1b.

C. Antenna.

The antenna is an AS-133/APX (Collins part number 013 1078 00) or equivalent unit.

D. The Power Supplies.

The power supplies provide 115 volts, 300-1000 cps a-c and 27.5 volts d-c power. Power requirements are 167 va of a-c and 0.3 ampere of d-c.

E. Types of Installations.

The 621A-2 may be installed in a single or dual installation. Figures 2, 3, and 4 present typical installations. Complete installation information is given in the Installation Manual.

5. SPECIFICATIONS.

A. Cooling.

Cooling air may be supplied from the blower mounted on the front panel of the 621A-2 or as described in ARINC Specification 404. When cooled as specified in ARINC Specification 404, the unit requires 48 pounds of cooling air per hour at a temperature of 30 degrees centigrade. The 621A-2 is equipped with a dust cover with the cooling air openings specified in ARINC Specification 404. The blower operates when pin 36 of the rear connector of the 621A-2 is connected to pin 30 of the same connector. Such a connection completes the a-c ground lead to the blower. For an ARINC forced cooled installation, this connection is removed in the radio rack installation. For a nonforced cooled installation, this connection is made as outlined before.

CAUTION: THE ATC TRANSPONDER 621A-2 SHOULD NOT BE OPERATED WITHOUT ADEQUATE COOLING AIR.

B. Electrical Specifications.

(1) General.

(a) Transmitter frequency: 1090 mc

(b) Receiver frequency: 1030 mc

(c) Frequency control: Transmitter - stabilized cavity oscillator; receiver - crystal controlled

(d) R-f impedance: 50 ohms

(e) Altitude: 30,000 feet

(f) Number of tubes: 26

(g) Power requirements.

1. Standby.

a. 27.5 volts d-c at 0.2 ampere

b. 115 volts a-c, 400 cps at 110 va

c. Power factor = 0.95

2. Operate: Zero replies

a. 27.5 volts d-c at 0.3 ampere

b. 115 volts a-c, 400 cps at 138 va

c. Power factor = 0.96

3. Operate: 12,000 reply pulses per second

a. 27.5 volts d-c at 0.3 ampere

b. 115 volts a-c, 400 cps at 167 va

c. Power factor = 0.95

(h) Case size: 1/2 ATR

(i) Weight: ATC Transponder 621A-2, 27.9 lb; shockmount, 2.1 lb.

(2) Transmitter-Receiver.

(a) Transmitter peak power output: 500 watts nominal

(b) Transmitter frequency stability: ±2.5 mc

(c) Receiver sensitivity: High -74 dbm; low -62 dbm

(d) Over-all delay: 3.0 ±0.5 microseconds

(e) Reply pulse spacing: 2.9 microseconds ATC Transponder 621A-2, part number 522 1571 00; 1.45 microseconds ATC Transponder 621A-2, part number 522 1572 00

(f) Reply code spacing tolerance: ±0.1 microsecond

(g) Receiver selectivity: Less than 3-db attenuation at ±3.5 mc, greater than 60-db attenuation at ±25 mc

(h) Modes of interrogation: 8, 17 microseconds spacing ATC Transponder 621A-2, part number 522 1571 00; 8, 17 and two of 19, 21, 23, or 25 microseconds spacing ATC Transponder 621A-2, part number 522 1572 00

(i) Side-lobe suppression: 50-db dynamic range with 9-db amplitude discrimination

C. Vacuum-Tube Complement.

Vacuum tubes in ATC Transponder 621A-2 are identified in table 3. All tubes are of the ARINC preferred type except the transmitter and modulator tubes.

TABLE 3. VACUUM-TUBE COMPLEMENT

CIRCUIT SYMBOL	FUNCTION	TYPE
*V101	Visual monitor	6111
*V102	Audio monitor	6111
V201	Local oscillator	5670
V202	Frequency multiplier	5654
V203	Transmitter oscillator	GL6442
V204	I-f amplifier	5654
V205	I-f amplifier	5654
V206	I-f amplifier	5654
V207	I-f amplifier	5654
V208	I-f amplifier	5654
V209	I-f amplifier	5654
V210	Video amplifier and cathode follower	5670
V211	Suppressor and cathode follower	5670
V301	Modulator	6293
V401	Code oscillator	5814A
V402	Differentiator amplifier	5670
V403	Identification coincidence	5725
V404	Modulator trigger blocking oscillator	5670
V405	Modulator trigger	5814A
V406	Modulator driver	5687
V407	Receiver output and transmitter trigger	5670
V408	ASR coincidence	5725
V501	Suppression multivibrator	5670
V502	Gate blocking oscillator	5814A
V601	Delay line amplifier and cathode follower	5814A
V602	Comparator	5670
V603	Decoder coincidence	5725
V604	Suppressor generator	5687

*Custom modification

D. Fuse Complement.

Table 4 presents a listing of the fuses used in ATC Transponder 621A-2.

TABLE 4. FUSE COMPLEMENT

SYMBOL	LOCATION	SPECIFICATION	FUNCTION
F301	Modulator	3/4 amp Slo-Blo	High-voltage fuse
F703	Power supply	0.125 amp Slo-Blo	-180 v fuse
F702	Power supply	0.25 amp Slo-Blo	+140 v fuse
F701	Power supply	2 amp Slo-Blo	115 v a-c fuse

E. Diode Complement.

Table 5 presents a listing of the diodes used in ATC Transponder 621A-2.

TABLE 5. DIODE COMPLEMENT

SYMBOL	TYPE	LOCATION	NOTES
*CR101	1N629	Chassis	
*CR102	1N457	Chassis	
*CR103, CR104	Zener TI653C9	Chassis	
**CR110	1N628	Chassis	
CR201	1N251	R-f module	
CR202	1N21C	R-f module	
CR203	1N251	R-f module	
CR205	1N251	R-f module	
CR301A/B	Selenium	Modulator	Special Collins part number 353 0266 00
CR401	1N251	Encoder	
CR402	1N251	Encoder	

*Visual monitor circuit, a custom modification.
**Audio monitor circuit, a custom modification.

TABLE 5. DIODE COMPLEMENT (Cont)

SYMBOL	TYPE	LOCATION	NOTES
CR403	1N629	Encoder	
CR406	6003	Encoder	or 1N463
CR501	1N629	Encoder gate	
CR502	1N629	Encoder gate	
CR503 through CR511	6003	Encoder gate	or 1N463
CR512 through CR518	6003	Encoder gate	Used in ATC Transponder 621A-2, part number 522 1572 00 only
CR601 through CR606	1N629	Decoder	
CR607 through CR612	1N629	Decoder	Used in ATC Transponder 621A-2, part number 522 1572 00 only
CR613 through CR618	1N629	Decoder	
CR619	6009	Decoder	
CR620	6007	Decoder	
CR621	1N629	Decoder	
CR622	1N629	Decoder	
CR623	6003	Decoder	or 1N463
CR624	1N629	Decoder	
CR701 through CR706	1N1096	Power supply	

F. Crystal Complement.

Table 6 lists the crystal which is used in the 621A-2.

TABLE 6. CRYSTAL COMPLEMENT

SYMBOL	FUNDAMENTAL FREQUENCY
Y201	90.83333 mc

6. OPERATION.

ATC Transponder 621A-2 is an integral part of an Air Traffic Control Radar Beacon System. Figure 10 illustrates the general characteristics of such a system.

A ground interrogator transmits pulse pair interrogations at a frequency of 1030 mc from a rotating antenna.

The receiver section of ATC Transponder 621A-2 accepts the interrogation signal, and if the signal has the desired characteristics, initiates a reply signal. ATC Transponder 621A-2, Collins part number 522 1571 00, can be interrogated in either of two modes of operation (mode A or mode B). In mode A, pulse pairs which are spaced at 8-microsecond intervals are accepted. In mode B, pulse pairs which are spaced at 17-microsecond intervals are accepted. See figure 8.

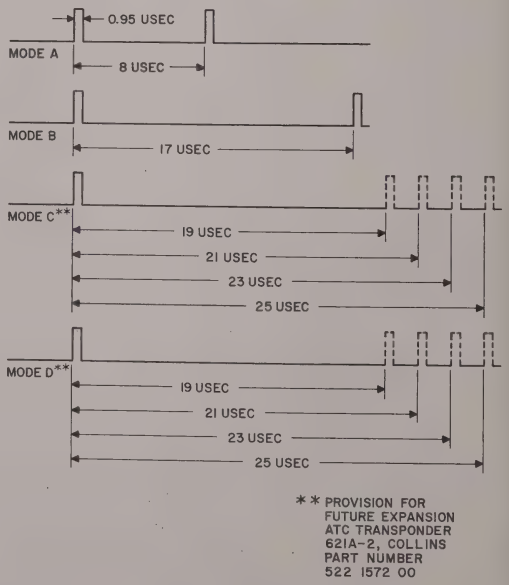
ATC Transponder 621A-2, Collins part number 522 1572 00, can be interrogated in either mode A or mode B, but in addition has the required circuitry to be interrogated in either of two additional modes (mode C or mode D). In modes C and D, when they become available, pulse pair spacings will be chosen from possible 19-, 21-, 23-, or 25-microsecond spacings. See figure 8.

The mode of operation is selected by the pilot. Upon receipt of a proper interrogation, the 621A-2 transmits a reply signal. The reply signal from ATC Transponder 621A-2, Collins part number 522 1571 00, is in the form of 2 to 8 accurately spaced pulses 2.9 microseconds apart. See figure 9. The first and eighth pulse of each pulse code are called framing pulses. The second to seventh pulses are called information pulses. The framing pulses are always present and are spaced 20.3 microseconds apart. The information pulses may be transmitted in various combinations depending upon the code selected by the pilot on the code selector of the control unit. Each pulse is 0.4 microsecond wide.

An identification pulse may be transmitted immediately following the code pulses. This identification pulse is transmitted at a frequency of 1090 mc and is spaced 24.65 microseconds after the first framing pulse of the reply code.

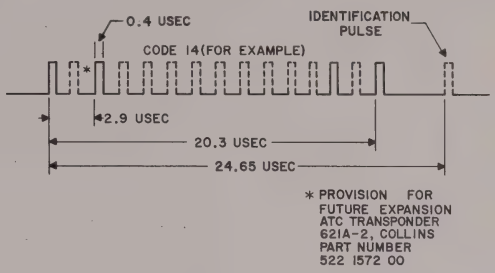
ATC Transponder 621A-2, Collins part number 522 1572 00, has the circuitry to provide seven additional interspaced pulses at a frequency of 1090 mc. Transmission from this unit is thus in the form of 2 to 15 accurately spaced pulses 1.45 microseconds apart and an identification pulse at 1090 megacycles. These seven additional information pulses permit the pilot to choose additional reply codes when they are assigned and become available.

The reply signal from the 621A-2 is received by the ground responder, and the aircraft position is displayed on a plan position



Interrogating Signal from the ATC Interrogator
Figure 8

indicator. See figure 10. At the discretion of the controller, the raw video can be displayed on the PPI. Through the use of a decoder, all transponder-equipped aircraft can be displayed as a single blip, all aircraft transmitting the code which is selected by the controller as a double blip, and aircraft transmitting the identification or position code as a wide "bloomer" blip. The reply pulses can be used to indicate a variety of flight information to the air traffic controller. For example, the reply pulse code can indicate which controller has the responsibility for the control of the aircraft, where the flight is to terminate, and possible emergency conditions. With the expanded code capacity of ATC Transponder 621A-2, Collins part number 522 1572 00, additional information can be transmitted.

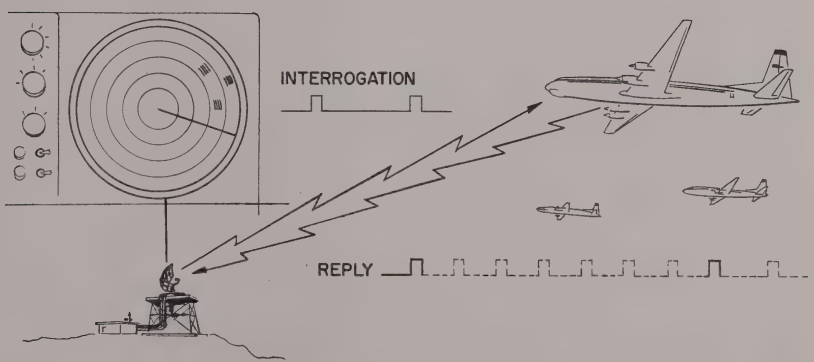


Reply Signal, ATC Transponder 621A-2
Figure 9

A. Block Diagram Theory of Operation.

A block diagram of ATC Transponder 621A-2 is shown in figure 11.

The interrogation signal, which is received from the ATC interrogator is heterodyned and detected in the r-f section of the 621A-2. The r-f section consists of a preselector, crystal



INTERROGATION	REPLY
1030 MC	1090 MC
MODE A 8 MICROSECONDS	64 CODES: 2 TO 8 PULSES SPACED 2.9
MODE B 17 MICROSECONDS	MICROSECONDS AND SPECIAL
	IDENTIFICATION PULSE

Air Traffic Control Radar Beacon System
Figure 10

diode mixer, crystal-controlled local oscillator, i-f amplifier, video amplifier, decoder cathode follower, and suppressor. The preselector uses three coaxial resonators which provide excellent rejection of image and other spurious responses. The crystal-controlled receiver local oscillator provides improved stability and permits the use of a relatively narrow-band i-f amplifier for improved rejection of off-channel signals. The i-f amplifier employs six stages of amplification with stagger tuning to provide a gain of approximately 80 db with a minimum of 8 megacycles total bandwidth and center frequency of 60 megacycles.

The output of the i-f amplifier is applied to the video amplifier. The output of the video amplifier (waveform A) is divided into two channels referred to as the spike eliminator input and the decoder input.

The decoder input is delayed by an amount equal to the desired time spacing between interrogation pulses which will be accepted. This delay is selected by the pilot through the mode selection circuits of the 621A-2 and the mode selector switch of the control unit.

The spike eliminator input is passed through the spike eliminator circuit, which discriminates against noise in the received signal. The spike eliminator circuit uses a spike eliminator cathode follower (located in the r-f module) and a delay line and coincidence circuit. Pulses having durations of less than 0.3 microsecond are eliminated. The output of the spike eliminator (waveform B) is transmitted to the side-lobe suppression circuit which measures difference in amplitude between the first and second pulses of the interrogation pulse pair. If the first pulse of an interrogating signal is 9 db or greater than the second pulse, the circuit recognizes the interrogating pulse pair to be a result of side-lobe radiation and prevents decoding by the coincidence tube. If the amplitudes of the first and second pulses are approximately equal, the side-lobe suppression circuit determines that the pulses have originated from main-lobe radiation and permits decoding.

The decoder, a passive type, recognizes a proper interrogating signal and rejects all other signals. The proper interrogating signal will consist of a pair of pulses spaced 8 microseconds apart, mode A; 17 microseconds apart, mode B; or 19, 21, 23, or 25 microseconds apart, modes C and D. The desired mode is selected by the mode selector of the external control unit. When a proper interrogation is received, the decoder transmits a single trigger pulse (waveform C) to a keying circuit, which initiates the encoded reply signal.

The keying circuit, which is located in the encoder gate module produces a 100-microsecond gating pulse (waveform D) having a duration longer than the time required to complete the reply pulse train. The gating pulse turns on the timing oscillator which provides the precise timing reference voltage used to position the pulses. The oscillator produces two sine-wave signals (waveforms E and G) that are identical except for a phase difference of 180 degrees. The period of the sine wave which determines the position of the alternate reply pulses is 2.9 microseconds. Each sine-wave signal is applied to separate channels.

One channel (the code pulse selector channel) provides the framing pulses and the information pulses present in the reply code of ATC Transponder 621A-2, Collins part number 522 1571 00. See figure 6. The second channel (the intermediate pulse selector channel) provides the additional interspaced pulses for the reply code of ATC Transponder 621A-2, Collins part number 522 1572 00. See figure 7.

Each sine wave is applied to its respective pulse generator which produces timed trigger pulses (waveforms F and H) having a rise time of 0.2 microsecond and a pulse width of approximately 0.35 microsecond. The trigger pulses obtained from the code pulse selection channel is shown by waveform F. These pulses are 2.9 microseconds apart. The trigger pulses obtained from the intermediate pulse selection channel is shown by the waveform H.

These pulses are also 2.9 microseconds apart. The pulse generator circuit is composed of a diode voltage comparator followed by amplification and differentiation. The comparator is referenced to zero volt, and thus the output trigger pulses occur when the sine-wave voltage crosses the zero point going from positive to negative. As a result, timing errors between pulses of the reply train due to changes in oscillator amplitude and damping factor are minimized.

The keyer circuit, in addition to producing the gating pulse for the timing oscillator, simultaneously produces a pulse for the selector gate generator. The selector gate generator produces a two-microsecond pulse output for the selector delay network. Fifteen two-microsecond pulses are taken from the delay network at time delay increments of 1.45 microseconds. These pulses are divided into two channels. The code pulse selector channel contains pulses spaced at 2.9-microsecond intervals which are obtained by connecting to alternate taps on the delay line. The intermediate pulse selector channel contains pulses also spaced at 2.9-microsecond intervals which are obtained by connecting to the remaining taps of the delay line.

The diode switches located in each channel are remotely controlled by the pilot's code selector and determine which of the gating pulses will be applied to the coincidence circuits. The gating pulses applied to the coincidence tubes permit the selected trigger pulses to be transmitted through the coincidence circuits to the modulator. ATC Transponder 621A-2, Collins part number 522 1571 00, has only the required diodes to produce gating pulses from the code selector channel. ATC Transponder 621A-2, Collins part number 522 1572 00, has the additional diodes to produce the interspaced gating pulses from the intermediate pulse selector channel.

With the output circuits of the coincidence circuits connected together, an output is obtained when any trigger pulse and gating pulse are time coincident. Thus when the pilot selects the gating pulse arrangement, he is also selecting the desired output pulses. The output pulses (waveform K) have the same characteristics as the trigger pulses. These output signal pulses are known as the encoded reply signal.

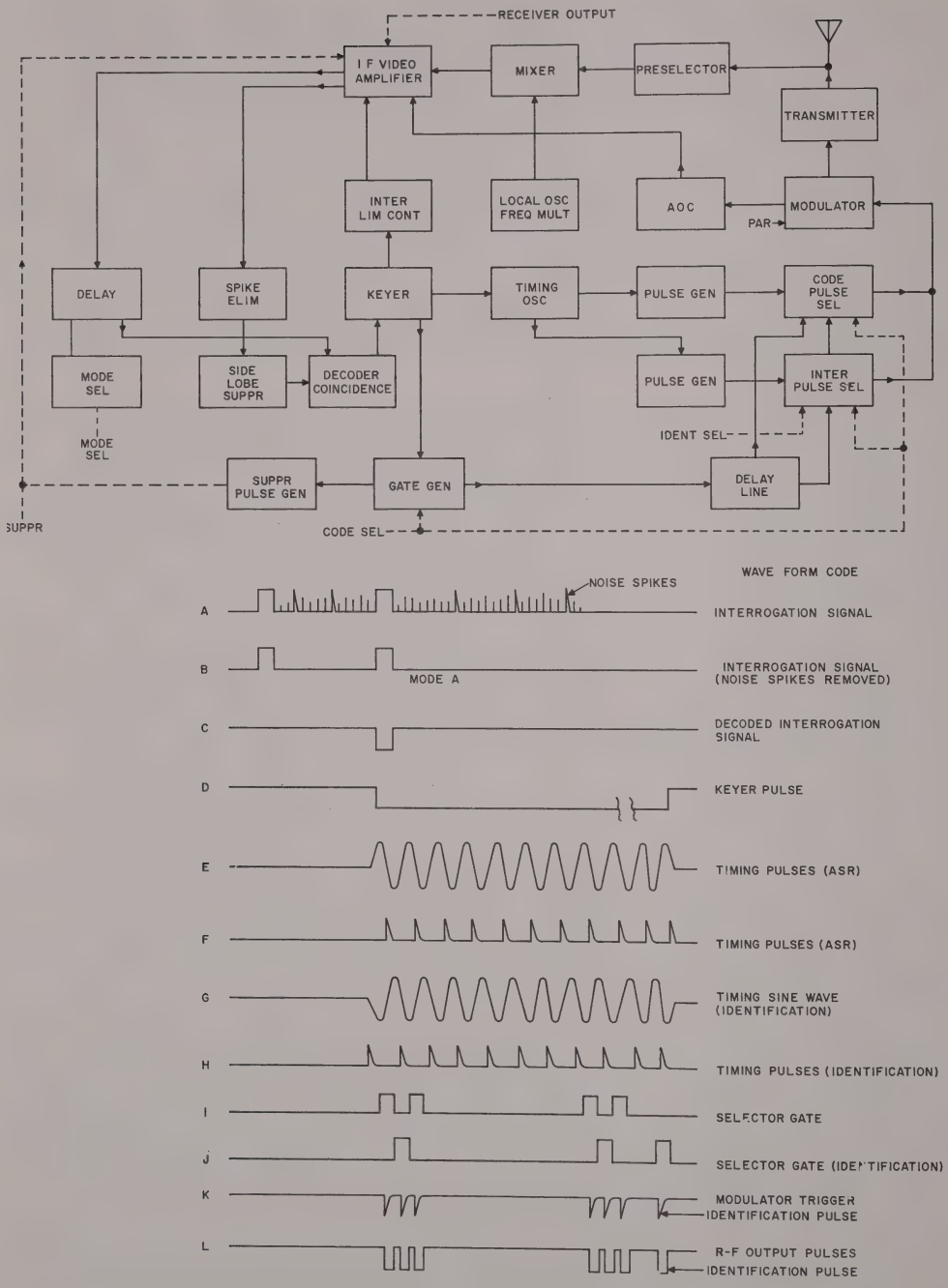
The encoded reply signal is applied to the modulator where it is amplified and shaped so as to produce pulses of the proper duration and amplitude to modulate the transmitter.

The transmitter consists of an oscillator which uses two coaxial resonators and a ceramic disc-seal tube operating at 500 watts peak pulse power. The oscillator is plate pulsed and produces the reply signal at 1090 mc (waveform L). The reply is applied to the common antenna and transmitted back to the ATC interrogator. At least 50 db of attenuation is present in the preselector at the transmitting frequency so that adequate receiver protection is provided.

The modulator also keys an automatic output control system which applies a voltage to the i-f amplifier to prevent the 621A-2 from being overloaded by an excessive number of reply pulses. A special external suppressor circuit, which is located in the r-f module, permits the 621A-2 to be suppressed by signals received from external equipment when this equipment is operating. Other external equipment, such as DMET, may be suppressed by signals received from the 621A-2. The suppression circuit also suppresses the i-f strip of the r-f module when the 621A-2 is transmitting. An input is also provided to trigger the modulator from an external source, as in PAR interrogation.

The keyer also actuates an interrogation limit control system which applies a bias to the i-f amplifier to prevent overloading of the transponder by an excessive number of interrogations.

An output is provided so that the video signal may be supplied to external equipment.



ATC Transponder 621A-2, Block Diagram
Figure 11

B. Detailed Theory of Operation.

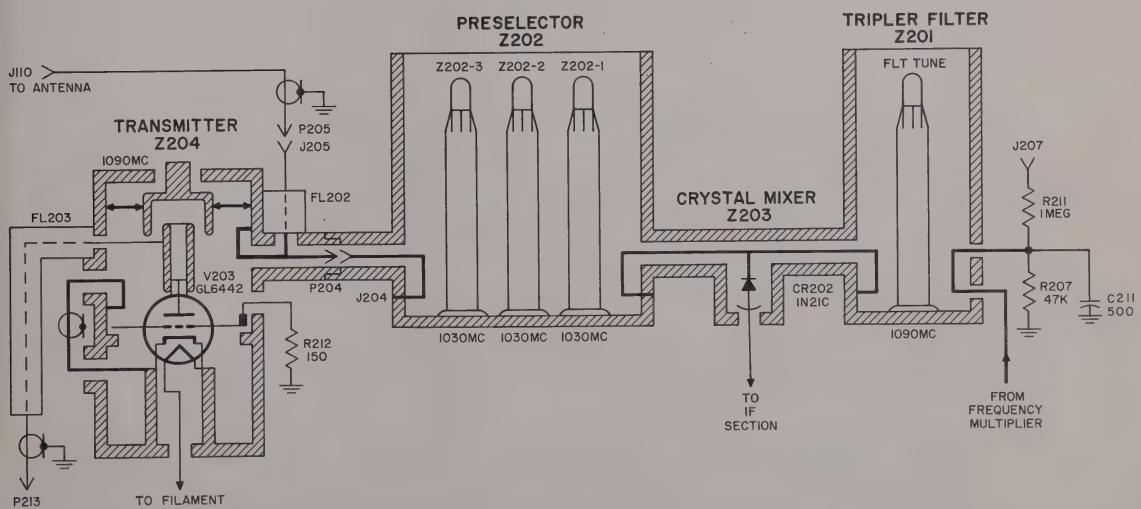
Interrogation pulses from the ground station interrogator are received at the antenna (AS-133/APX or equivalent) and applied through J110 (the ANT jack on the front panel of the 621A-2) to the r-f module of the 621A-2.

(1) R-F Module.

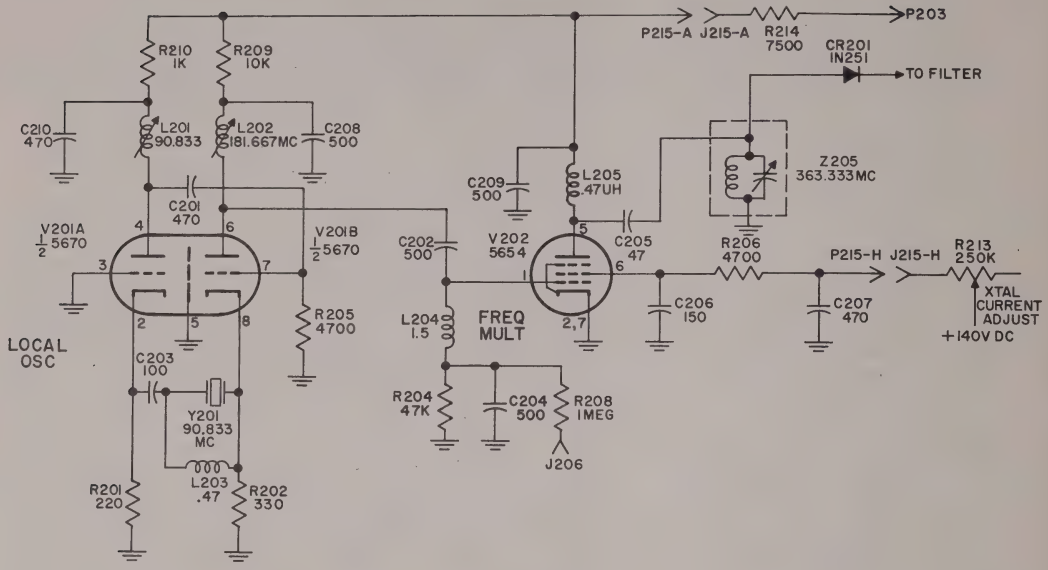
Interrogation pulses which are received at the antenna are applied through J110 to P205, J205, P204, and J204 to the preselector Z202.

The preselector, Z202, consists of three tuned lines without inside walls. See figure 12. The three lines are tuned at 1030 megacycles. The preselector has essentially no insertion loss at the receive frequency of 1030 megacycles and provides approximately 50 db of attenuation at the transmit frequency of 1090 megacycles. This prevents the transmitter from damaging the receiver crystal mixer and provides antenna changeover between transmit and receive operation. The preselector output is applied to crystal diode mixer CR202 and mixed with a 1090-megacycle injection signal from the tripler filter, Z201. The tripler tuner is fed from the local oscillator chassis. The local oscillator (V201) is a dual triode which operates as a crystal-controlled, cathode-coupled, oscillator stage. See figure 13. V201A operates as a grounded-grid amplifier with the plate circuit inductor, L201, tuned to the crystal frequency of 90.8333 megacycles. The r-f energy from the plate circuit of V201A is coupled by C201 onto the grid of V201B. V201B is connected as a cathode follower. The voltage developed across resistor R202 is coupled onto the cathode of V201A via a CR54U crystal, Y201, and capacitor C203. At the series-resonant frequency of the crystal (90.8333 megacycles), there is no phase shift through the crystal, the cathode voltages are in phase, and the circuit is regenerative.

The oscillator load inductor, L202, is tuned to twice the crystal frequency of 90.8333 megacycles. The resulting 181.666-megacycle signal is coupled onto the grid of frequency multiplier V202.



R-F Cavities, Simplified Schematic Diagram
Figure 12



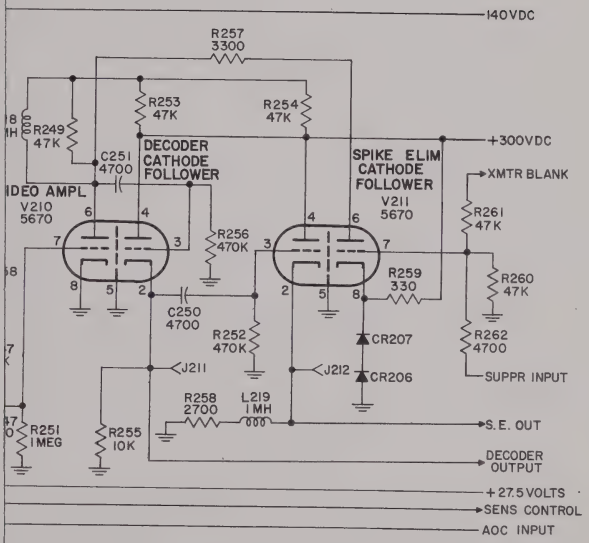
Local Oscillator and Frequency Multiplier, Simplified Schematic Diagram
Figure 13

The shunt-fed frequency doubler stage, V202, has its parallel-tuned plate circuit tuned to 363.333 megacycles. The doubled frequency of 363.333 megacycles, which is developed across Z205, is multiplied by diode tripler CR201 and appears as a tripled frequency of 1090 megacycles at tripler filter Z201. The grid bias, which is developed on the grid of V202, can be measured at test point J206. The tripler drive can be measured at J207. The voltage at J206 is approximately -5 volts d-c. The voltage at J207 is approximately +4 volts d-c.

The 1090-megacycle output from the single-tuned tripler filter, Z201, together with the 1030-megacycle signal frequency output from the preselector are injected to the crystal mixer cavity, Z203, and appear across crystal diode mixer CR202. The crystal mixer cavity is single tuned to a frequency of 1030 megacycles. A 60-megacycle difference frequency is obtained across the detector crystal, CR202, and applied to the i-f amplifier section through J202 and P202. See figure 14. Crystal mixer current is adjusted by the crystal current adjust potentiometer, R213, which adjusts the tripler drive by varying the screen voltage of V202.

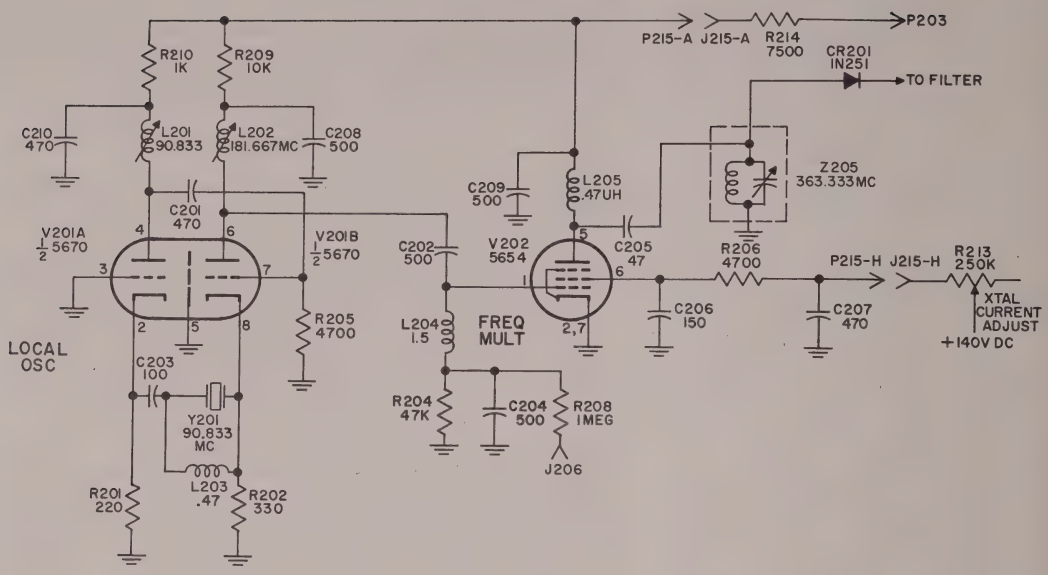
The signal from CR202 is coupled through matching inductor L209 and coupling capacitor C217 to the grid of the first i-f amplifier, V204. L208 and R215 provide a d-c ground for the crystal mixer. Crystal mixer current can be monitored at test jack J208.

The i-f amplifier uses single-tuned circuits and is made up of two overstaggered triple stages in cascade. One triple is composed of V204, V205, and V206. The other triple is composed of V207, V208, and V209. Both triples are identical in circuitry. L210 is tuned to 60 megacycles. L211 is tuned to 64 megacycles, and L212 is tuned to 56 megacycles. L213 is tuned to 64 megacycles, L214 is tuned to 56 megacycles, and L215 is tuned to 60 megacycles.



NOTE:
1. UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE OHMS, ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS AND ALL INDUCTANCE VALUES ARE MICROHENRYS.

I-F Amplifier and Detector, Simplified
Schematic Diagram
Figure 14



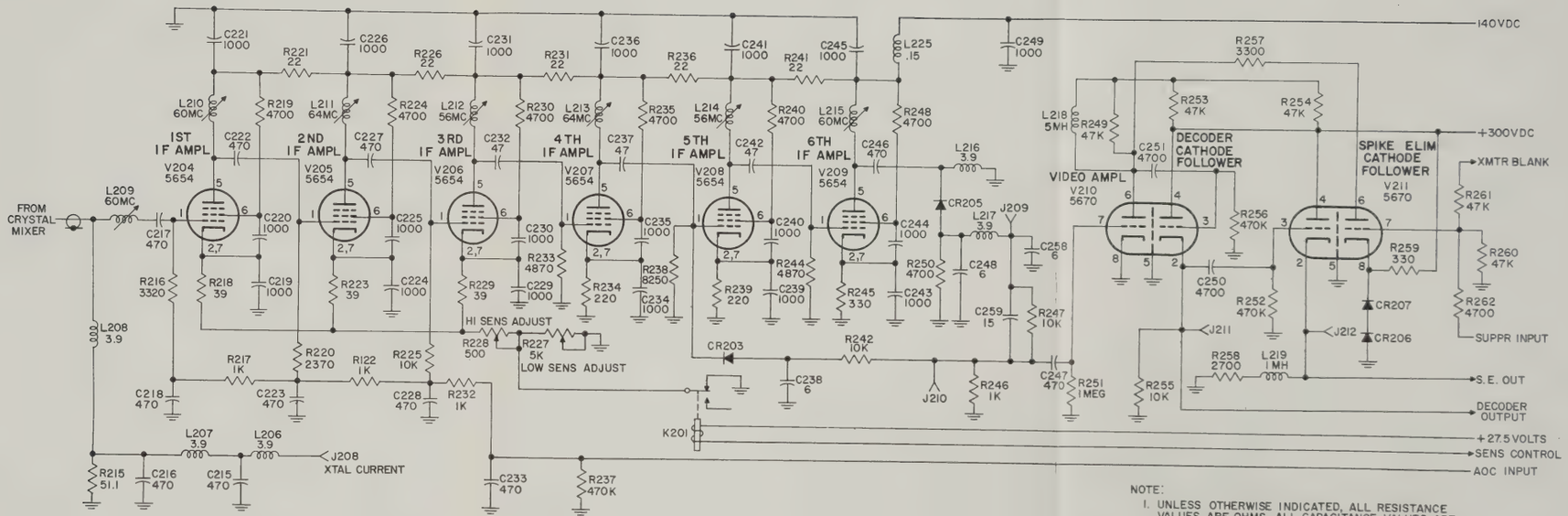
Local Oscillator and Frequency Multiplier, Simplified Schematic Diagram
Figure 13

The shunt-fed frequency doubler stage, V202, has its parallel-tuned plate circuit tuned to 363.333 megacycles. The doubled frequency of 363.333 megacycles, which is developed across Z205, is multiplied by diode tripler CR201 and appears as a tripled frequency of 1090 megacycles at tripler filter Z201. The grid bias, which is developed on the grid of V202, can be measured at test point J206. The tripler drive can be measured at J207. The voltage at J206 is approximately -5 volts d-c. The voltage at J207 is approximately +4 volts d-c.

The 1090-megacycle output from the single-tuned tripler filter, Z201, together with the 1030-megacycle signal frequency output from the preselector are injected to the crystal mixer cavity, Z203, and appear across crystal diode mixer CR202. The crystal mixer cavity is single tuned to a frequency of 1030 megacycles. A 60-megacycle difference frequency is obtained across the detector crystal, CR202, and applied to the i-f amplifier section through J202 and P202. See figure 14. Crystal mixer current is adjusted by the crystal current adjust potentiometer, R213, which adjusts the tripler drive by varying the screen voltage of V202.

The signal from CR202 is coupled through matching inductor L209 and coupling capacitor C217 to the grid of the first i-f amplifier, V204. L208 and R215 provide a d-c ground for the crystal mixer. Crystal mixer current can be monitored at test jack J208.

The i-f amplifier uses single-tuned circuits and is made up of two overstaggered triple stages in cascade. One triple is composed of V204, V205, and V206. The other triple is composed of V207, V208, and V209. Both triples are identical in circuitry. L210 is tuned to 60 megacycles. L211 is tuned to 64 megacycles, and L212 is tuned to 56 megacycles. L213 is tuned to 64 megacycles, L214 is tuned to 56 megacycles, and L215 is tuned to 60 megacycles.



NOTE:
1. UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE OHMS, ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS AND ALL INDUCTANCE VALUES ARE MICROHENRYS.

I-F Amplifier and Detector, Simplified Schematic Diagram
Figure 14

The gain of the i-f amplifier is approximately 80 db with a minimum of 8 megacycles total bandwidth. The center frequency is 60 megacycles. The gain of the i-f amplifier is adjusted by varying the cathode bias of tubes V204, V205, and V206. When the control unit is set to ON, relay K201 grounds the bottom of the HI SENS adjust potentiometer, R228. The gain of the i-f amplifier is then adjustable by the setting of R228. When the control unit is set to LO SENS (low sensitivity), ground is made at the bottom of the LO SENS adjust potentiometer, R227. The gain of the i-f amplifier is then adjustable by the setting of R227.

The control grids of V204, V205, and V206 are connected to an automatic output control (AOC) line from the decoder module. The AOC circuits reduce the gain of the i-f amplifier during an excessive number of interrogations and prevents overloading of the 621A-2. The AOC line is also linked to the transmitter overload (XTMR O.L.) circuit which samples the total number of replies and will not let the transmitter duty cycle be exceeded when a low interrogation rate is used with a high number of replies per group.

The output of the sixth i-f amplifier is applied to crystal diode detector CR205 through C246, and the output from the fourth i-f amplifier is applied to crystal detector CR203 through C237 and added across a common load resistor, R246. This arrangement permits 50 db of dynamic range on the i-f section.

The i-f output is applied to the grid of video amplifier V210, pin 7. The output of the video amplifier is obtained from pin 6 of V210A and is coupled through C251 to the grid, pin 3, of the decoder cathode follower, V210B. The output of the decoder cathode follower, obtained at pin 2 of V210B, is fed to J106-5 of the decoder module. The output is also fed through C250 to the grid, pin 3, of the spike eliminator cathode follower, V211A. The output, pin 2, of the spike eliminator cathode follower is fed to J106-21 of the decoder module. The spike eliminator input (J106-21) and decoder input (J106-5) form the two input signals to the decoder module.

The suppression circuit is composed of V211B, CR207, CR206, R259, and R257. Signals which will cause the tube to conduct are received from the decoder and a transmitter blanking circuit. The video amplifier tube is cut off when the suppressor tube conducts. Suppression trigger pulses are obtained internally when the 621A-2 is transmitting and are applied through the SUPPR jack on the front panel of the 621A-2 to suppress external equipment. The transmitter blanking signal is obtained from the encoder module and is also used to suppress the receiver when the 621A-2 is transmitting.

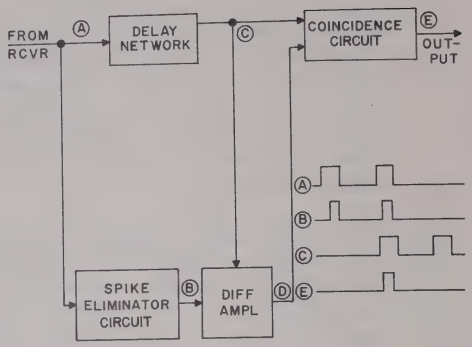
(2) Decoder Module.

The decoder module contains the circuits which analyze the received interrogation signal, accepts those interrogation signals which have the proper characteristics, and initiates the reply signal. In addition, the module contains the suppressor gate generator and AOC detector.

Figure 15 is a block diagram of the decoding circuits. Figure 16 is a simplified schematic diagram of the decoder module. One channel, referred to as the spike eliminator (S.E.) input, is applied to the spike eliminator circuits of the decoder module. The other channel, referred to as the decoder input, is applied through C601 to the delay line network. A portion of the decoder input signal is also applied to the receiver output cathode follower, V407A, of the encoder module.

The delay line network is composed of a multitapped delay line, DL602, and a series of diodes, capacitors, and resistors. The tapped leads of the delay line (which are labeled

A, B, C, and D) are brought to the rear connector of ATC Transponder 621A-2 and are interconnected to the control unit. The mode of operation is selected by the pilot when he sets the mode selector switch of the control unit to the desired mode and grounds the corresponding lead of the delay line. When the lead is grounded, the decoder input pulse is delayed by an amount equal to the spacing between interrogation pulses; in mode A it is 8 microseconds, in mode B it is 17 microseconds. The delay line is terminated by resistor R620. The output of the delay line circuit (waveform C, figure 15) is attenuated by R641 and R627 and applied to the grid, pin 2, of the delay line cathode follower, V601A. The cathode, pin 3, of V601A is coupled directly to the cathode of the grounded-grid amplifier, V601B. A positive pulse is coupled through C612 from the plate of V601B to the second control grid, pin 7, of the decoder coincidence tube, V603.



Decoder Circuits, Block Diagram
Figure 15

Decoding is accomplished when a coincidence occurs at V603, resulting in an output trigger pulse (waveform E, figure 15) at P606-12 of the decoder module. A coincidence occurs when the second pulse of the interrogation pulse pair, which is applied via the spike eliminator and side-lobe suppression circuits to the first control grid of V603, is in coincidence with the delayed pulse applied to the second control grid. Since the pulse applied to the second control grid has been delayed by an amount equal to the desired spacing between interrogation pulses, coincidences (decoding) can occur for properly spaced interrogation pulses.

(a) Spike Eliminator Circuits.

The spike eliminator circuit rejects noise and interference pulses and provides an undelayed output for the side-lobe suppression circuits. The spike eliminator input to the decoder module is passed through a 0.3-microsecond delay line, DL601, and is taken out at the junction of R651 and CR617. The leading edge of each pulse is delayed 0.3 microsecond, and the trailing edge is clamped by CR617 to zero volt when the input pulse falls to zero, thus 0.3 microsecond is cut off the front of each input pulse (waveform B, figure 15). This circuit reduces triggering due to extraneous noise spikes and due to narrow pulses which might be generated by either external equipment or noise. The spike eliminator output is attenuated by R643 and R636, then applied to the grid, pin 7, of the comparator tube (V602) of the side-lobe suppression circuits.

(b) Side-Lobe Suppression.

Side-lobe suppression circuits are required in ATC Transponder 621A-2 to prevent decoding from side-lobe radiations of the ground radar interrogator antenna.

When the 621A-2 is situated a great distance from the ground radar interrogator, a response is obtained only during the time the ground antenna points to the airborne

The gain of the i-f amplifier is approximately 80 db with a minimum of 8 megacycles total bandwidth. The center frequency is 60 megacycles. The gain of the i-f amplifier is adjusted by varying the cathode bias of tubes V204, V205, and V206. When the control unit is set to ON, relay K201 grounds the bottom of the HI SENS adjust potentiometer, R228. The gain of the i-f amplifier is then adjustable by the setting of R228. When the control unit is set to LO SENS (low sensitivity), ground is made at the bottom of the LO SENS adjust potentiometer, R227. The gain of the i-f amplifier is then adjustable by the setting of R227.

The control grids of V204, V205, and V206 are connected to an automatic output control (AOC) line from the decoder module. The AOC circuits reduce the gain of the i-f amplifier during an excessive number of interrogations and prevents overloading of the 621A-2. The AOC line is also linked to the transmitter overload (XTMR O.L.) circuit which samples the total number of replies and will not let the transmitter duty cycle be exceeded when a low interrogation rate is used with a high number of replies per group.

The output of the sixth i-f amplifier is applied to crystal diode detector CR205 through C246, and the output from the fourth i-f amplifier is applied to crystal detector CR203 through C237 and added across a common load resistor, R246. This arrangement permits 50 db of dynamic range on the i-f section.

The i-f input is applied to the grid of video amplifier V210, pin 7. The output of the video amplifier is obtained from pin 6 of V210A and is coupled through C251 to the grid, pin 3, of the decoder cathode follower, V210B. The output of the decoder cathode follower, obtained at pin 2 of V210B, is fed to J106-5 of the decoder module. The output is also fed through C250 to the grid, pin 3, of the spike eliminator cathode follower, V211A. The output, pin 2, of the spike eliminator cathode follower is fed to J106-21 of the decoder module. The spike eliminator input (J106-21) and decoder input (J106-5) form the two input signals to the decoder module.

The suppression circuit is composed of V211B, CR207, CR206, R259, and R257. Signals which will cause the tube to conduct are received from the decoder and a transmitter blanking circuit. The video amplifier tube is cut off when the suppressor tube conducts. Suppression trigger pulses are obtained internally when the 621A-2 is transmitting and are applied through the SUPPR jack on the front panel of the 621A-2 to suppress external equipment. The transmitter blanking signal is obtained from the encoder module and is also used to suppress the receiver when the 621A-2 is transmitting.

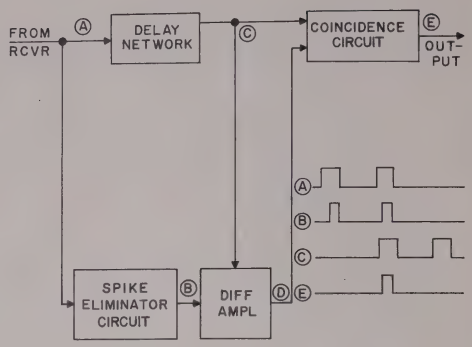
(2) Decoder Module.

The decoder module contains the circuits which analyze the received interrogation signal, accepts those interrogation signals which have the proper characteristics, and initiates the reply signal. In addition, the module contains the suppressor gate generator and AOC detector.

Figure 15 is a block diagram of the decoding circuits. Figure 16 is a simplified schematic diagram of the decoder module. One channel, referred to as the spike eliminator (S.E.) input, is applied to the spike eliminator circuits of the decoder module. The other channel, referred to as the decoder input, is applied through C601 to the delay line network. A portion of the decoder input signal is also applied to the receiver output cathode follower, V407A, of the encoder module.

The delay line network is composed of a multitapped delay line, DL602, and a series of diodes, capacitors, and resistors. The tapped leads of the delay line (which are labeled

A, B, C, and D) are brought to the rear connector of ATC Transponder 621A-2 and are interconnected to the control unit. The mode of operation is selected by the pilot when he sets the mode selector switch of the control unit to the desired mode and grounds the corresponding lead of the delay line. When the lead is grounded, the decoder input pulse is delayed by an amount equal to the spacing between interrogation pulses; in mode A it is 8 microseconds, in mode B it is 17 microseconds. The delay line is terminated by resistor R260. The output of the delay line circuit (waveform C, figure 15) is attenuated by R641 and R627 and applied to the grid, pin 2, of the delay line cathode follower, V601A. The cathode, pin 3, of V601A is coupled directly to the cathode of the grounded-grid amplifier, V601B. A positive pulse is coupled through C612 from the plate of V601B to the second control grid, pin 7, of the decoder coincidence tube, V603.



Decoder Circuits, Block Diagram
Figure 15

Decoding is accomplished when a coincidence occurs at V603, resulting in an output trigger pulse (waveform E, figure 15) at P606-12 of the decoder module. A coincidence occurs when the second pulse of the interrogation pulse pair, which is applied via the spike eliminator and side-lobe suppression circuits to the first control grid of V603, is in coincidence with the delayed pulse applied to the second control grid. Since the pulse applied to the second control grid has been delayed by an amount equal to the desired spacing between interrogation pulses, coincidences (decoding) can occur for properly spaced interrogation pulses.

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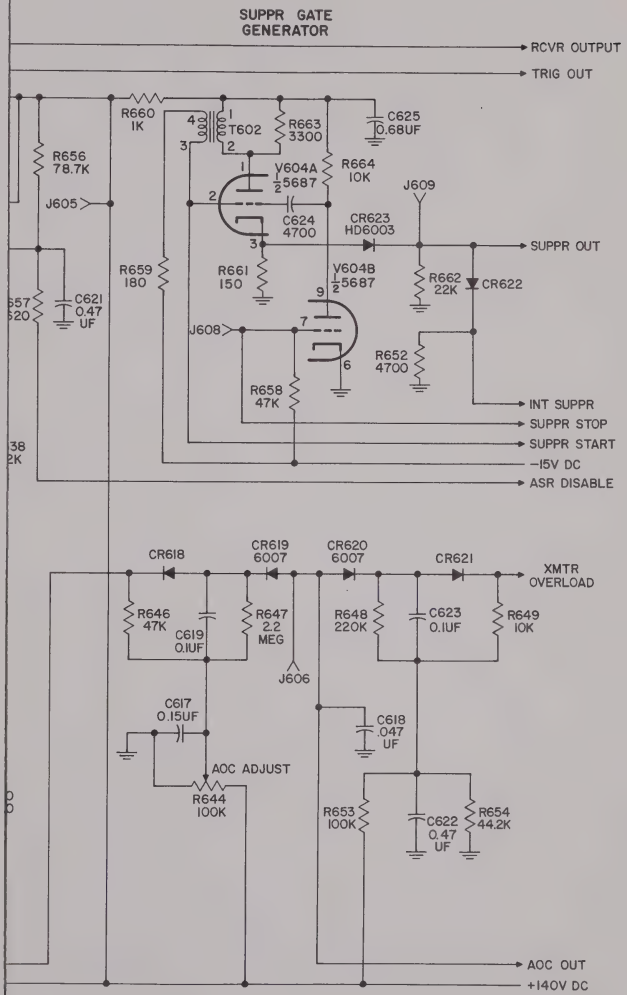
The spike eliminator circuit rejects noise and interference pulses and provides an undelayed output for the side-lobe suppression circuits. The spike eliminator input to the decoder module is passed through a 0.3-microsecond delay line, DL601, and is taken out at the junction of R651 and CR617. The leading edge of each pulse is delayed 0.3 microsecond, and the trailing edge is clamped by CR617 to zero volt when the input pulse falls to zero, thus 0.3 microsecond is cut off the front of each input pulse (waveform B, figure 15). This circuit reduces triggering due to extraneous noise spikes and due to narrow pulses which might be generated by either external equipment or noise. The spike eliminator output is attenuated by R643 and R636, then applied to the grid, pin 7, of the comparator tube (V602) of the side-lobe suppression circuits.

(b) Side-Lobe Suppression.

Side-lobe suppression circuits are required in ATC Transponder 621A-2 to prevent decoding from side-lobe radiations of the ground radar interrogator antenna.

When the 621A-2 is situated a great distance from the ground radar interrogator, a response is obtained only during the time the ground antenna points to the airborne

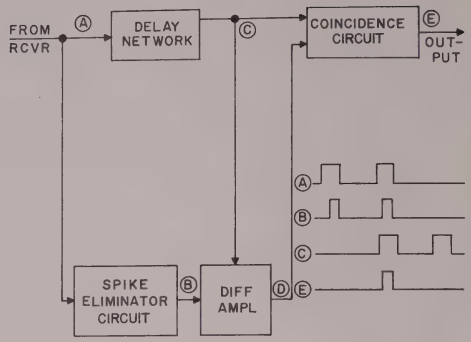


ICROMICROFARADS, AND ALL INDUCTANCE

D ALLOW ADDITIONAL MODES OF INTERROGATION.

Decoder Module, Simplified
Schematic Diagram
Figure 16

A, B, C, and D) are brought to the rear connector of ATC Transponder 621A-2 and are interconnected to the control unit. The mode of operation is selected by the pilot when he sets the mode selector switch of the control unit to the desired mode and grounds the corresponding lead of the delay line. When the lead is grounded, the decoder input pulse is delayed by an amount equal to the spacing between interrogation pulses; in mode A it is 8 microseconds, in mode B it is 17 microseconds. The delay line is terminated by resistor R260. The output of the delay line circuit (waveform C, figure 15) is attenuated by R641 and R627 and applied to the grid, pin 2, of the delay line cathode follower, V601A. The cathode, pin 3, of V601A is coupled directly to the cathode of the grounded-grid amplifier, V601B. A positive pulse is coupled through C612 from the plate of V601B to the second control grid, pin 7, of the decoder coincidence tube, V603.



Decoder Circuits, Block Diagram
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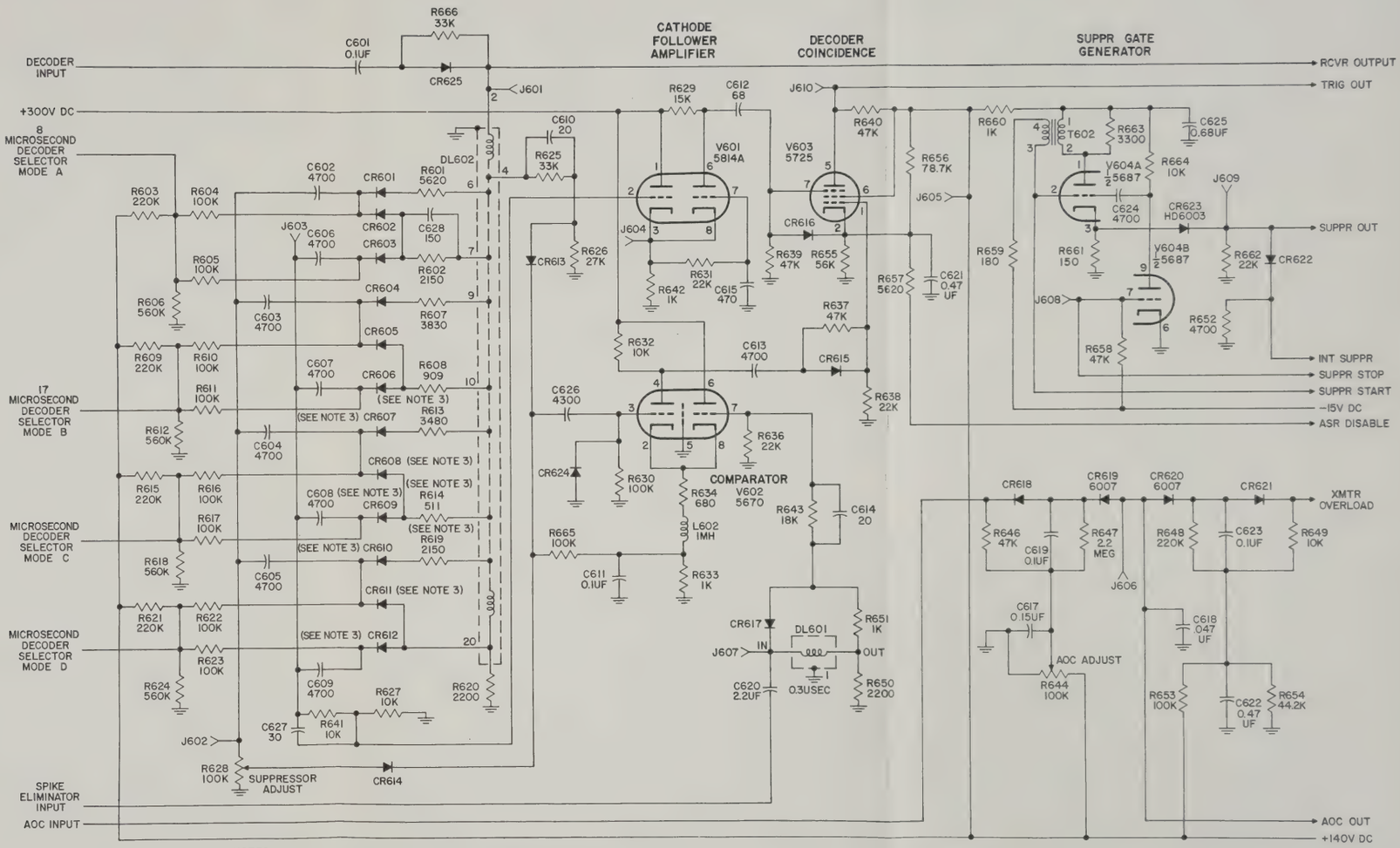
(b) Side-Lobe Suppression.

Side-lobe suppression circuits are required in ATC Transponder 621A-2 to prevent decoding from side-lobe radiations of the ground radar interrogator antenna.

When the 621A-2 is situated a great distance from the ground radar interrogator, a response is obtained only during the time the ground antenna points to the airborne



NOTES:

1. ALL DIODES ARE 6554 UNLESS OTHERWISE INDICATED.
2. UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS, AND ALL INDUCTANCE VALUES ARE IN MICROHENRYS.
3. THESE COMPONENTS ARE PRESENT IN ATC TRANSPONDER 621A-2, COLLINS PART NUMBER 522-1572-00, AND ALLOW ADDITIONAL MODES OF INTERROGATION.

Decoder Module, Simplified
Schematic Diagram
Figure 16

antenna. In this case, the main lobe of the ground antenna pattern is active in producing airborne replies, and the secondary or side lobes are unimportant since they contain insufficient power to activate the airborne receiver. As the distance between interrogator and transponder decreases, a point is reached where the power contained in the secondary lobes of the interrogating antenna is sufficient to activate the airborne receiver. As shown in figure 17, extraneous replies are received at incorrect azimuth positions on the plan position indicator. As the distance between the interrogator and transponder is reduced further, all of the secondary lobes are powerful enough to activate the airborne receiver, and a continuous ring of replies are displayed with constant radius equal to the separation distance. The airborne receiver must, therefore, be able to separate main-lobe interrogations from secondary lobe interrogations and refuse the latter signals.

As shown in figure 18, the interrogator provides a two-pulse interrogation where the first pulse is radiated from the omnidirectional pattern, and the second pulse of the pair is radiated from the directional pattern. Both pulses are transmitted at the same frequency. An interrogation originating from the main antenna lobe will consist of two pulses having equal amplitudes. When the interrogation originates from a secondary antenna lobe, however, the amplitude of the first pulse will be greater than that of the second pulse by at least 9 db. The vertical patterns of the omnidirectional and directional antenna must be nearly identical if the relationship of the first and second pulse is to remain essentially constant for any elevation angle.

The side-lobe suppression circuit must suppress interrogations where the first pulse is 9 db, or more, greater than the second pulse over a signal level range of 50 db, and accept interrogations when the first pulse is equal in amplitude to the second pulse within ±3 db.

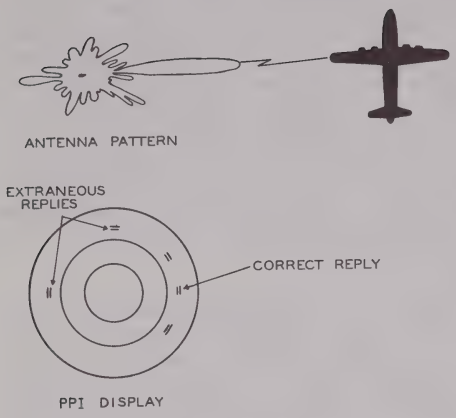
1. Side-Lobe Suppression Circuitry.

Side-lobe suppression is provided by the comparator tube, V602, which functions as a differential voltage amplifier.

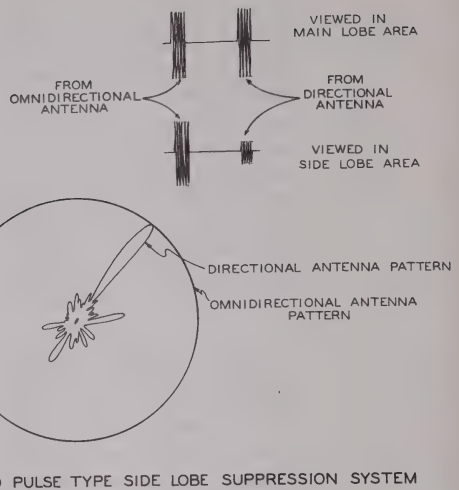
The spike eliminator input drives the grid, pin 7, of V602 positive and the plate, pin 4, positive. Pulses from the delay network are obtained from the wiper of R628, the SUPPR ADJ control, and drive the grid, pin 3, of V602 positive and the plate, pin 4, of V602 negative.

The amplitude of the pulse from the delay network is proportional to that of the first interrogation pulse, and the amplitude of the pulse from the spike eliminator circuit is proportional to the second interrogation pulse. With side-lobe interrogation, the pulse from the delay line network is larger than the pulse from the spike eliminator circuit, and the resulting large negative response at the plate, pin 4, of V602 suppresses any useful positive output due to the pulse from the spike eliminator circuit, and this prevents decoding by coincidence tube V603. A pulse is coupled from the two-microsecond tap of DL602 through CR613 which provides additional ditching action. R628, the SUPPR ADJ potentiometer, adjusts the amplitude of the pulse applied to grid 3 and thus adjusts the amplitude of the negative plate response to determine the amplitude discrimination level. Diode CR614 is back biased by a d-c voltage across R633 to provide a delay in suppression for signals at or near a minimum sensitivity level.

When the pulses from the spike eliminator circuit and delay line circuit are applied to V602 in time coincidence and the pulse from the spike eliminator



Ground Display with Side-Lobe Interference
Figure 17


VIEWED IN MAIN LOBE AREA
FROM OMNIDIRECTIONAL ANTENNA
FROM DIRECTIONAL ANTENNA
VIEWED IN SIDE LOBE AREA
DIRECTIONAL ANTENNA PATTERN
OMNIDIRECTIONAL ANTENNA PATTERN
TWO PULSE TYPE SIDE LOBE SUPPRESSION SYSTEM

Two-Pulse Type Side-Lobe Suppression System
Figure 18

circuit is equal to or slightly greater in magnitude than the pulse from the delay network, a positive output pulse is obtained. This pulse is applied to the first control grid, pin 1, of the coincidence tube, V603.

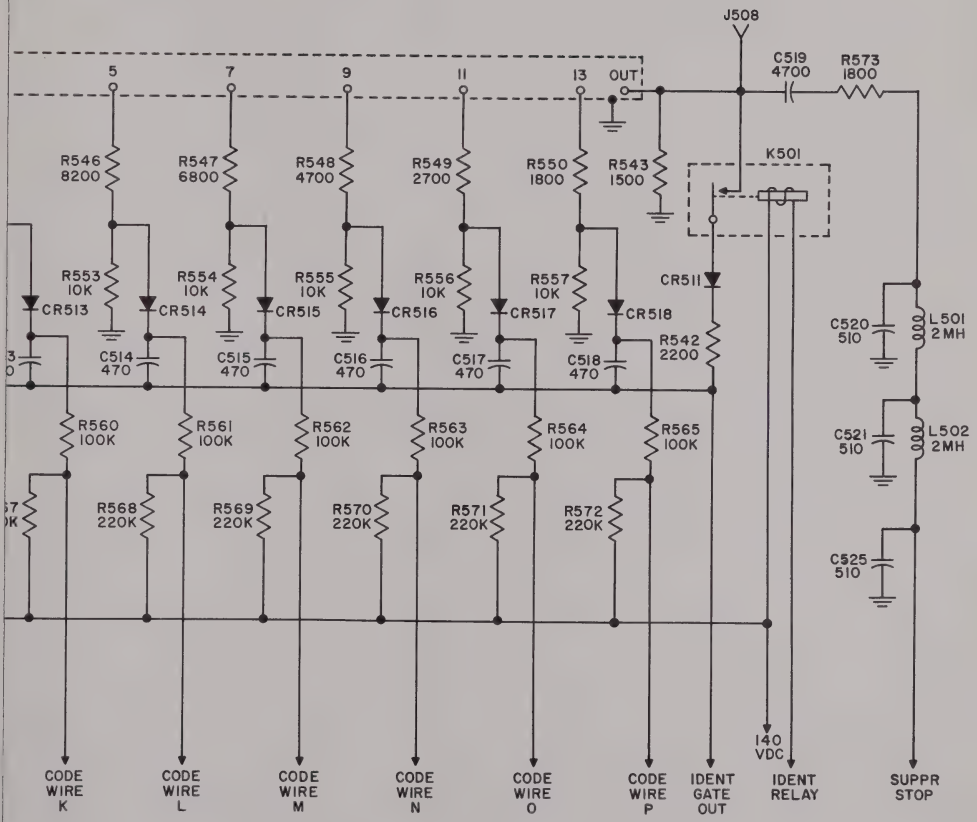
The suppression level is adjusted by R628 so that decoding is prevented if the first interrogation pulse exceeds the amplitude of the second interrogation pulse by 9 db or more.

(c) AOC Circuits.

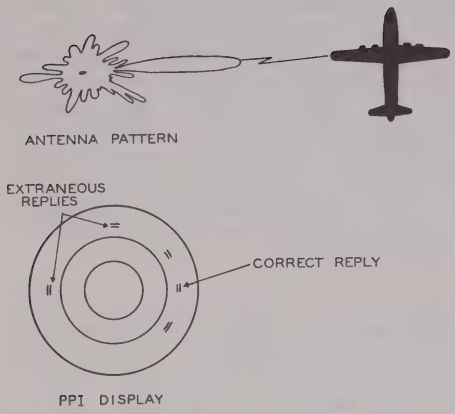
Negative pulses from pin 8 of the encoder gate module are applied to the automatic output control (AOC) detector composed of CR618, R646, R647, and C619. A negative d-c voltage appears at the junction of CR618 and CR619. This voltage becomes more negative as the number of interrogations per second increase. A positive d-c voltage appears at the arm of R644 (AOC ADJ) and is adjustable by R644. When the negative voltage generated by the automatic output control detector is equal to the magnitude of the positive voltage, CR619, which is referenced to ground on the AOC line, will just start to conduct. As the negative voltage from the AOC detector increases further, CR619 conducts and causes the AOC line to become negative and reduce the sensitivity of the i-f amplifier. This prevents the 621A-2 from being overloaded by a very high interrogation rate. The AOC ADJ threshold is set in the factory to count down the interrogations if the interrogation rate exceeds 1600 interrogations per second.

(d) Transmitter Overload Detector.

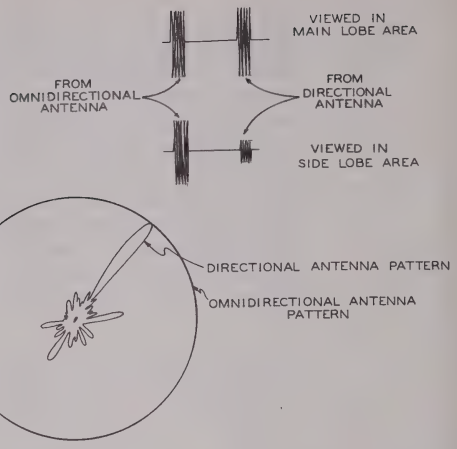
Negative pulses from pin 4 of the encoder module are applied to the transmitter overload detector composed of CR621, R649, R648, and C623. Basically the circuit operation is the same as the AOC circuit detector, but samples the total number of



Encoder Gate Module, Simplified Schematic Diagram
Figure 19



Ground Display with Side-Lobe Interference
Figure 17


VIEWED IN MAIN LOBE AREA
FROM OMNIDIRECTIONAL ANTENNA
FROM DIRECTIONAL ANTENNA
VIEWED IN SIDE LOBE AREA
DIRECTIONAL ANTENNA PATTERN
OMNIDIRECTIONAL ANTENNA PATTERN
TWO PULSE TYPE SIDE LOBE SUPPRESSION SYSTEM

Two-Pulse Type Side-Lobe Suppression System
Figure 18

circuit is equal to or slightly greater in magnitude than the pulse from the delay network, a positive output pulse is obtained. This pulse is applied to the first control grid, pin 1, of the coincidence tube, V603.

The suppression level is adjusted by R628 so that decoding is prevented if the first interrogation pulse exceeds the amplitude of the second interrogation pulse by 9 db or more.

(c) AOC Circuits.

Negative pulses from pin 8 of the encoder gate module are applied to the automatic output control (AOC) detector composed of CR618, R646, R647, and C619. A negative d-c voltage appears at the junction of CR618 and CR619. This voltage becomes more negative as the number of interrogations per second increase. A positive d-c voltage appears at the arm of R644 (AOC ADJ) and is adjustable by R644. When the negative voltage generated by the automatic output control detector is equal to the magnitude of the positive voltage, CR619, which is referenced to ground on the AOC line, will just start to conduct. As the negative voltage from the AOC detector increases further, CR619 conducts and causes the AOC line to become negative and reduce the sensitivity of the i-f amplifier. This prevents the 621A-2 from being overloaded by a very high interrogation rate. The AOC ADJ threshold is set in the factory to count down the interrogations if the interrogation rate exceeds 1600 interrogations per second.

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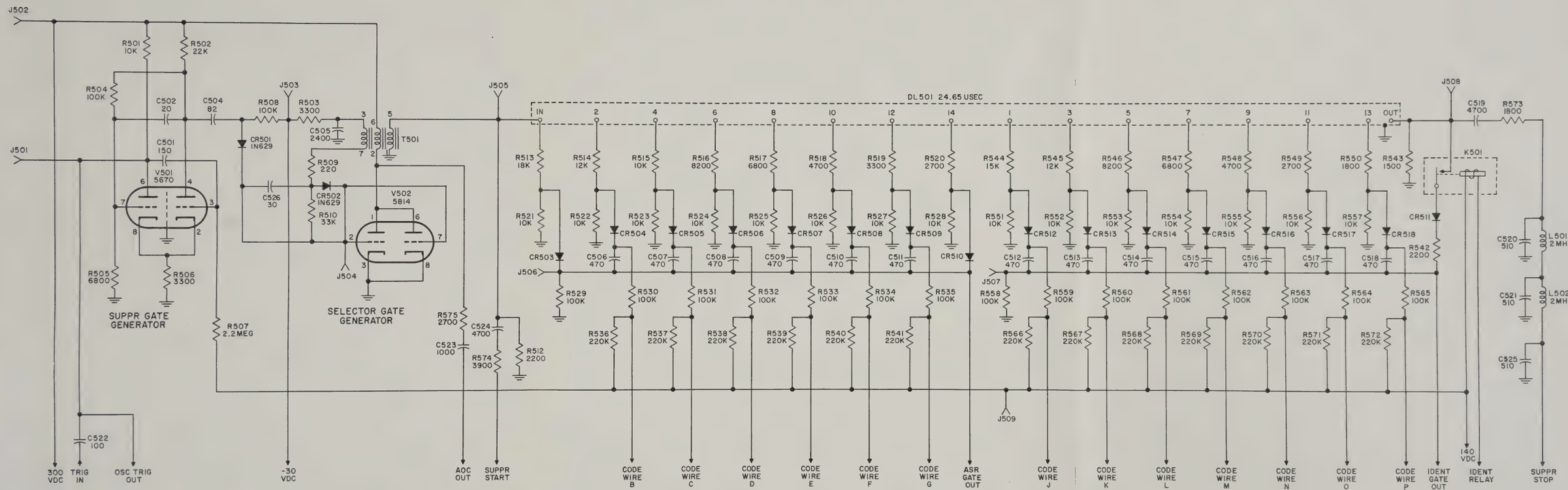


NOTES: 1. CR503 THUR CR518 ARE HD6003'S.
2. UNLESS OTHERWISE INDICATED: ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS AND ALL INDUCTANCE VALUES ARE IN MICROHENRYS.

Encoder Gate Module, Simplified Schematic Diagram
Figure 19

replies and will not let the transmitter duty cycle be exceeded when a low interrogation rate is used with a high number of replies per reply group.

(e) Suppression Circuits.

The suppressor gate generator, V604, is a blocking oscillator which is cut off with -15 volts fixed grid bias. A positive trigger pulse from pin 7 of the encoder gate module (SUPPR START) will trigger the blocking oscillator approximately one microsecond before the first transmitted reply pulse. The identification gate (SUPPR STOP) from pin 26 of the encoder gate module terminates the blocking oscillator approximately one microsecond after the identification pulse is transmitted. The positive output pulse from the cathode of the blocking oscillator is used to suppress the i-f amplifier and external equipments while the 621A-2 is transmitting.

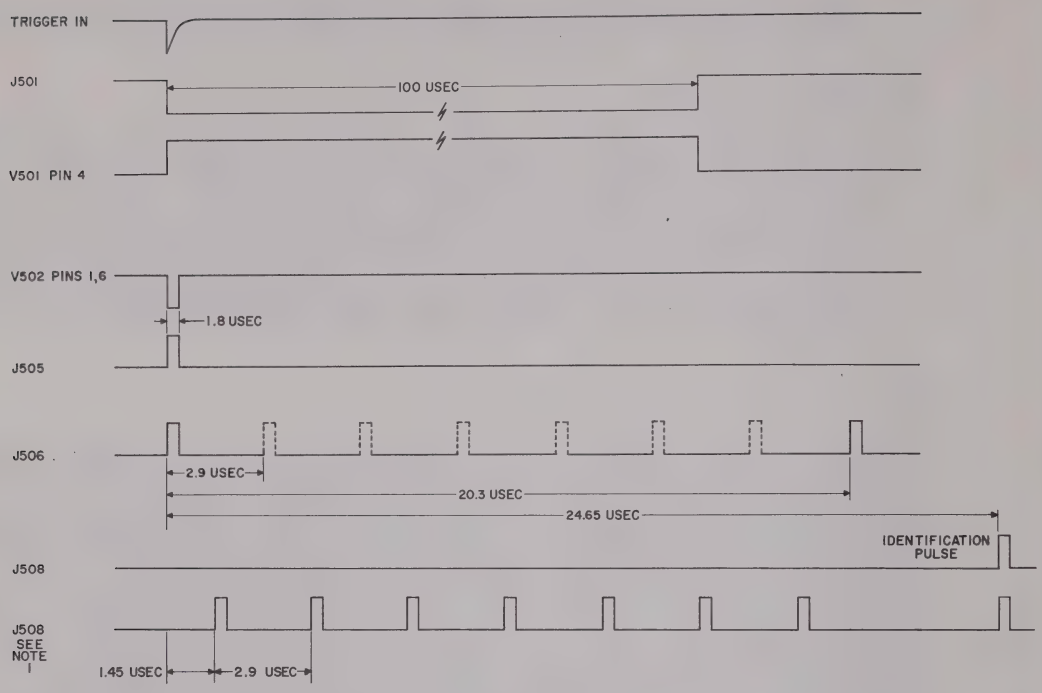
(3) Encoder Gate Module. (See figures 19 and 20.)

The trigger which is obtained from the decoder module is applied across a differentiating network composed of C522 and R501. This network prevents V501, a monostable multivibrator, from being triggered by pulses with a small slope which occur as a result of noise at the minimum trigger level. When the right-hand half section of V501 conducts, the left half is cut off. The negative trigger at pin 6 of V501 is coupled by C501 onto pin 3 of V501, cutting off the right half of the tube. This removes the cathode bias from the left half of the tube causing it to conduct. Conduction in the left half section causes the voltage at pin 6 to go negative and thus holds the right section cutoff. This condition will exist until capacitor C501 charges through R501 and R507 and removes the negative bias on the right-hand tube section. When this occurs, the circuit will revert to its original state. The duration of the pulse is determined mainly by the time constant of C501 and R502. The negative pulse, which has a duration of approximately 100 microseconds, is obtained from pin 6 of V501 and is transmitted to the encoder module to gate the timing oscillator, V401A. When a trigger has been received at V501, it cannot retrigger until it has passed through one cycle of operation. Thus, any pulses occurring less than 100 microseconds after the first trigger will not cause retriggering of this circuit of the 621A-2, and the 100-microsecond suppression time is generated.

The square positive 100-microsecond pulse from the plate, pin 4, of V501 is coupled to V502 through differentiating network C504 and R508 and diode CR501. V502 operates as a blocking oscillator, plate to grid coupled through T501, and is cut off by -30 volts applied to R503. The positive differentiated pulse at pin 2 causes V502 to conduct, and regeneration is initiated. A negative pulse of approximately 1.8 microseconds in width, which is determined by T501, C505, and R503, appears at V502, pins 1 and 6. The negative pulse is also applied to the AOC detector circuits of the decoder module. A positive pulse appears across the third winding of T501 and is applied to a 1000-ohm coding delay line, DL501. DL501 has various taps (1 through 13) spaced 1.45 microseconds apart. Resistor R543 terminates the delay line in 1500 ohms.

A pulse is obtained from the end of delay line DL501, is delayed 24.65 microseconds from the input pulse, and is referred to as the identification pulse. This identification pulse is obtained when relay K501, a sensitive relay connected in the plate of the identification time delay tube in the encoder module, is energized. The identification pulse is transmitted via P505-30, the IDENT GATE OUT terminal, to the encoder module.

The first frame pulse is taken from the input of the delay line through attenuating resistors R513 and R521. Each tap on the delay line has a corresponding pair of attenuation



NOTE
1. FOR ATC TRANSPONDER 621A-2, COLLINS PART NUMBER 522 157200.

Diagram of the Waveforms, Encoder Gate Module
Figure 20

resistors which have varying values due to the inherent attenuation, in the delay line. These resistors are chosen so that the selected pulse obtained on each tap of the delay line has the same amplitude.

Diodes CR503 and CR510 are connected in the circuit which produces the first and last frame pulses. Since these pulses are always present, CR503 and CR510 are not connected in the selector circuitry. These diodes isolate pulses obtained from the other taps from feeding into the front or back of the delay line. The framing pulses are 20.3 microseconds apart. The framing pulses are transmitted to the encoder module via P505-12, the ASR GATE OUT terminal.

In ATC Transponder 621A-2, Collins part number 522 1571 00, from 2 (2 framing and no information) to 8 (2 framing and 6 information) pulses spaced 2.9 microseconds apart are obtained. See figure 6. This is obtained by using alternate taps 2, 4, 6, 8, 10, 12, and 14 of the delay line which are linked through a series of diodes and resistors to the code wires B, C, D, E, F, and G. These code wires are linked to the code selection circuitry of the control unit. To obtain a particular code pulse, the corresponding code wire is grounded at the control unit. This places the end of the associated selector diode (CR504, CR505, CR506, CR507, and CR508) at ground potential, and a positive pulse from

the corresponding delay line tap is conducted to the collector bus. The collector bus is connected to pin 12, the ASR GATE OUT terminal, of P505. The pulse is then fed to the encoder module. If the code wire is not grounded, a positive 140 volts is placed on the negative end of the corresponding selector diode which prevents the pulse from being coupled to the collector bus. The identification pulse may be transmitted by closing relay K501 as previously explained.

In ATC Transponder 621A-2, Collins part number 522 1572 00, the additional code wires J, K, L, M, N, O, and P are connected to the pulse selection circuitry and are used to produce interspaced pulses. These interspaced pulses which are also 2.9 microseconds apart are placed between the pulses obtained from code wires B through G. A possible 2 (2 framing and no information) to 15 (2 framing and 13 information) pulses spaced 1.45 microseconds apart are obtained. The additional pulses are supplied to the encoder module through pin 30, the INDENT GATE OUT terminal. The identification pulse may be obtained as before. The additional circuitry to provide these pulses (available in ATC Transponder 621A-2, Collins part number 522 1572 00) is indicated by the dotted box in the over-all schematic diagram of ATC Transponder 621A-2. Diodes CR512 through CR518 are selector diodes which function in exactly the same manner as selector diodes CR504 through CR509.

Diodes CR504 through CR518 associated with each code wire are disconnect diodes which prevent other pulses from feeding back into any particular tap. Resistor R536 through R572 isolate the 140-volt line from ground as the selector wires are grounded.

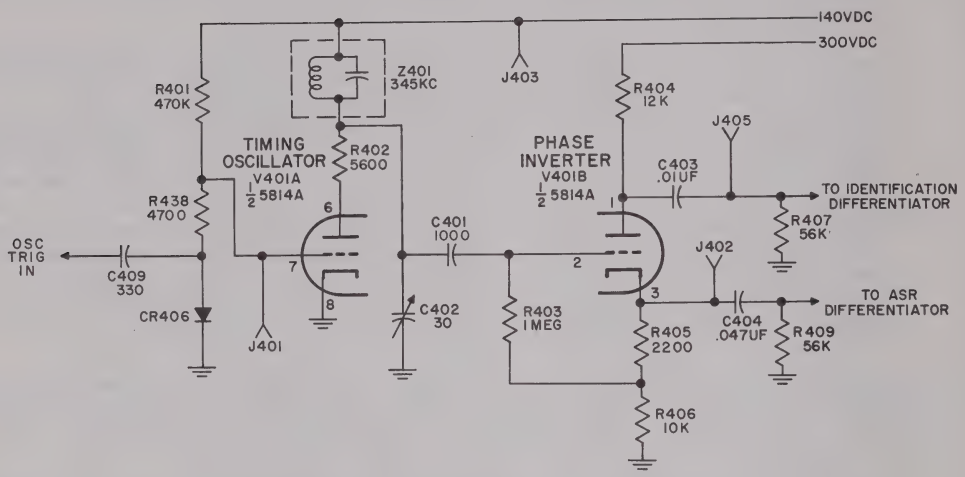
A suppressor start pulse is obtained approximately one microsecond before the first reply pulse. The suppressor stop pulse is obtained approximately one microsecond after the identification pulse is transmitted. These pulses are supplied to the suppression circuits of the decoder module.

(4) Encoder Module. (See figures 21, 22, 23, and 24.)

The negative 100-microsecond gate generated in the encoder gate module is coupled from P401, pin 9, across a differentiating network composed of C409, R438, and R401 onto pin 7 of timing oscillator V401A. A negative pulse which decays to zero in approximately 50 microseconds appears at pin 7. CR406 removes any positive pulses which may occur on the grid of V401 as the result of termination of the suppression multivibrator and also prevents ringing in timing oscillator V401A after the main oscillation. The negative pulse on the grid cuts off V401A; causing Z401 to oscillate at its natural resonant frequency of 345 kc. The oscillation from V401A is of a damped nature and will produce about 15 cycles before serious decaying occurs. The oscillation frequency of Z401 and, consequently, the pulse spacing is adjusted by C402. The 345-kc oscillation is coupled by C401 onto the grid of phase inverted V401B. Resistor R403 from grid to cathode presents a high impedance to the ringing oscillator.

The oscillation at the cathode, which is in phase with the grid voltage, is applied to a pulse forming circuit which eventually generates the two framing and six information pulses. Since the period of a sine wave occurring at 345 kc is 2.9 microseconds, and the identification pulse occurs 24.65 microseconds after the first frame pulse in an uneven multiple of 2.9 (several intervals of 2.9 microseconds plus one interval of 1.45 microseconds), it is necessary to phase invert the original oscillation to obtain negative-going zero crossing at points halfway between 2.9-microsecond spaced zero crossings.

The oscillation at pin 3 of V401B is applied to a comparison circuit consisting of CR402 and R422. This circuit transmits the negative half of the sine waves, provides a d-c

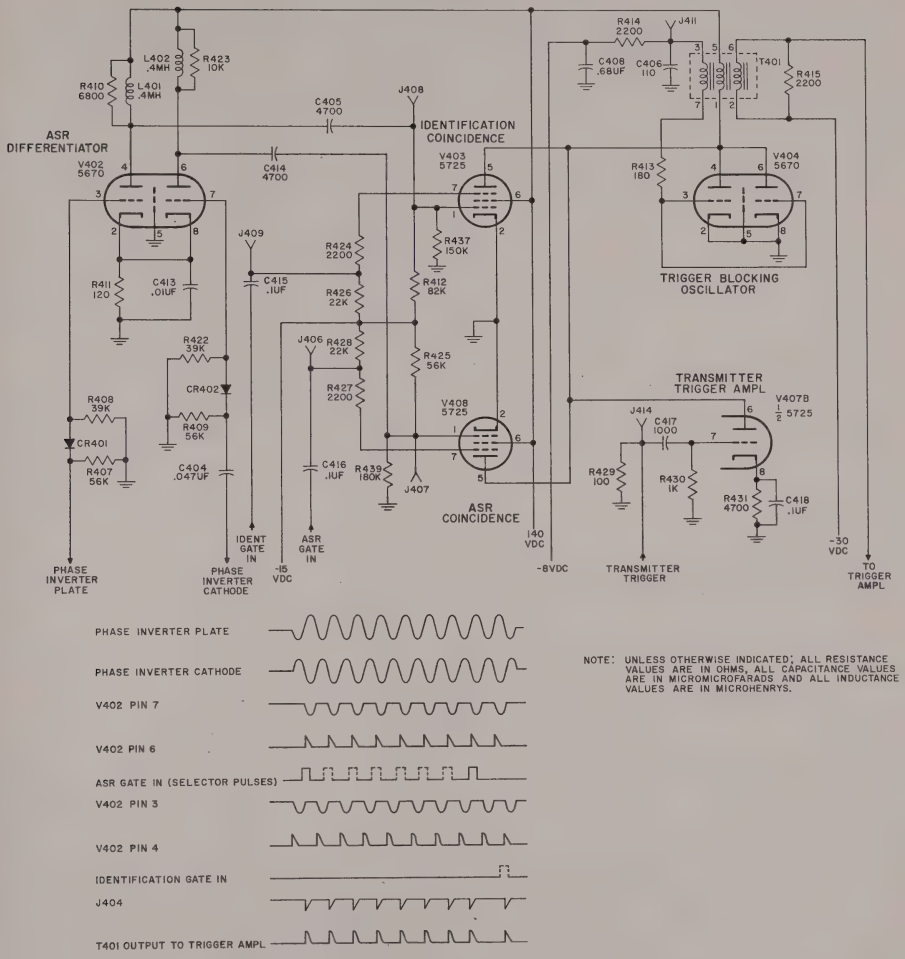


Timing Oscillator, Phase Inverter, and Identification Differentiater,
Simplified Schematic Diagram
Figure 21

reference at ground, and compares the negative-going zero potential crossings. The negative half-sine waves are applied to V402, pin 7. The other half of V402 conducts by virtue of approximately one volt of cathode bias. When the negative half-sine waves are applied to the grid, the tube is cut off. The very first part of each negative-going waveform cuts off this half of V402 producing in the plate circuit a positive pulse with a sharp leading edge. The plate impedance, L402 and R423, is a differentiating circuit. This differentiating circuit causes output at pin 6 to be a set of differentiated waveforms which have a fast rise time, a short duration, and which are timed accurately to the negative-going zero crossing of the 345-kc sine wave. Cathode voltage for this half of the tube is held constant during pulse time by bypass capacitor C413. Damping resistor R423 eliminates ringing in L402.

The positive spikes from pin 6 of V402 are coupled by C414 onto the control grid of the ASR coincidence tube V408; at the same time, selector pulses derived from the encoder gate generator are applied to the suppressor grid. V408 is normally cut off because of approximately -10 volts grid bias. When a differentiated pulse occurs in time coincidence with a selector pulse, a negative trigger is developed at the plate circuit.

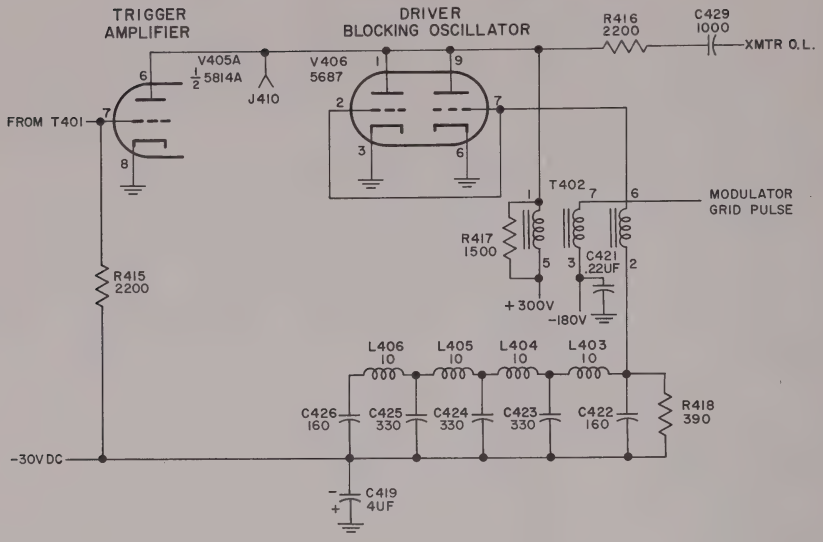
The sine wave obtained from the plate, pin 1, of V401 is applied to a similar pulse generator and coincidence circuit whose output occurs at the plate, pin 5, of V403 in



Pulse Generators, Code and Identification Differentiators,
Simplified Schematic Diagram
Figure 22

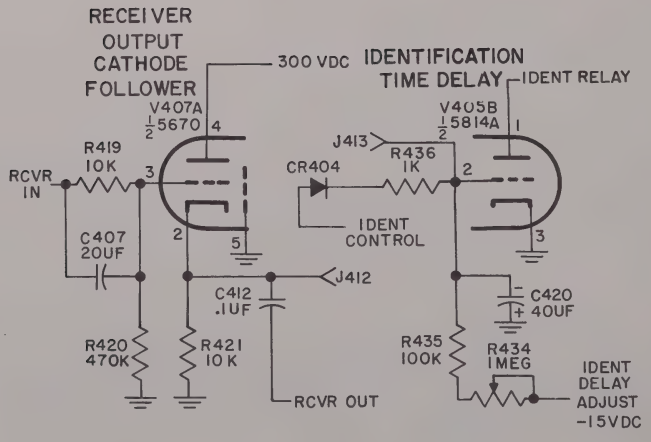
parallel with the output from V408, pin 5. The output from V403 is a short, sharp pulse similar to the identification pulse obtained from V408. The identification selector pulse derived in the encoder gate generator is applied to grid 7, so when there is time coincidence between the identification trigger pulses and the identification selector gate, an output occurs at pin 5 of V403.

The negative identification trigger from the plate of V403 is applied onto the plates of blocking oscillator V404. V404 is plate-to-grid coupled and normally is cut off



NOTE:
UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROMICROFARADS AND ALL INDUCTANCE VALUES ARE IN MICROHENRYS.

Trigger Amplifier and Driver Blocking Oscillator, Simplified Schematic Diagram
Figure 23



Receiver Output Cathode Follower and Identification Delay
Figure 24

by -8.0 volts present at R414. The output is a short, sharp pulse whose duration is a function of T401, C406, and R414. The positive trigger pulse is taken from the third winding of T401 and is applied to the grid of trigger amplifier V405A.

The input to the trigger amplifier is coupled from the TRIG IN connector on the front panel to transmitter trigger amplifier V407B via P401, pin 8. This positive trigger input triggers the transmitter on a pulse-for-pulse basis. A positive pulse on the grid of V407B causes a negative pulse on the plate pin 6 which, in turn, triggers blocking oscillator V404, R429, and R430; and d-c blocking capacitor C417 presents a 90-ohm impedance to the trigger input.

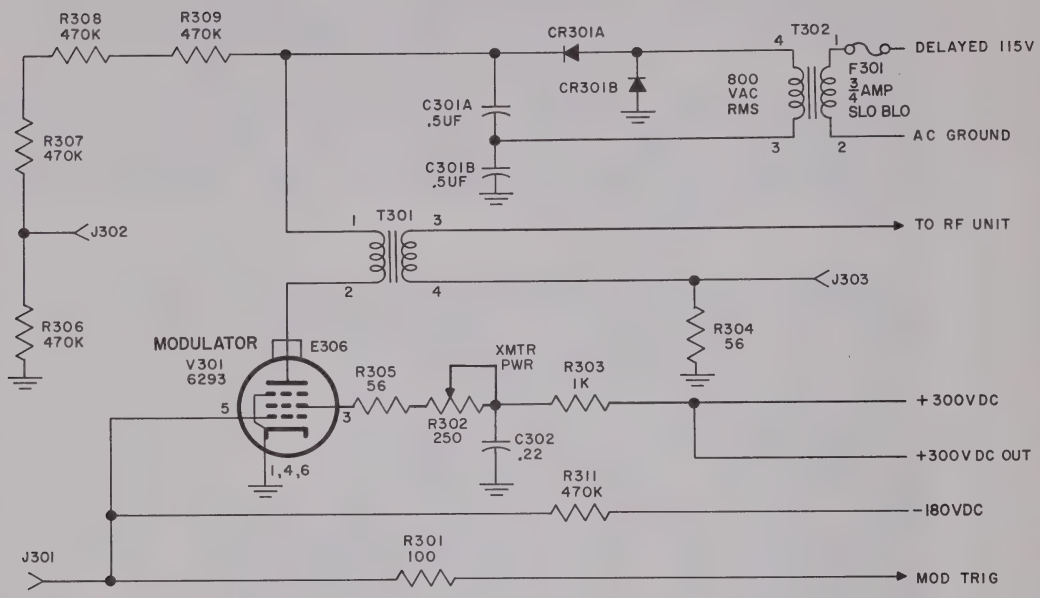
The positive trigger pulse output of T401, which is derived from either the framing, information, identification, or transmitter trigger pulses, is applied to V405A. See figure 23. A negative pulse from the plate of V405A triggers normally nonconducting V406. V406 is a pulse-shaping blocking oscillator and power amplifier used to drive the modulator. The period of the blocking oscillator is controlled by a delay line composed of L403 through L406 and C422 through C426. The delay line is a one-quarter-microsecond line so that the width of the blocking oscillator is approximately 0.5 microsecond (the time required for a pulse to go to the end of the line and back again). The output of T402, a 280-volt, half-microsecond pulse, is applied to the modulator module via P404, pin 14. Ferrite transformers T401 and T402, paralleled by R415 and R417 to prevent back swings, allow the transmitter trigger to recover within the required 1.4-microsecond time. Receiver pulses from the decoder module are applied across limiting resistor R419 onto pin 3 of receiver output cathode follower V407A. See figure 24. Output pulses of 2 to 12 volts amplitude are taken from the cathode of V407A and applied to a 90-ohm external load via the RCVR OUT connector on the front panel of the 621A-2.

V405B is the identification time delay tube. When the indentification switch is turned on and then released to off, the identification pulse will remain on from 6 to 15 seconds. When the identification control wire from pin 16 of P401 is ungrounded, the identification time delay V405B is cut off by -15 volts d-c fixed bias on its control grid. C402 is charged 15 volts negative from grid to ground. Since V405B is nonconducting and there is no plate current, the identification relay in the encoder gate module is de-energized. If the identification control wire is grounded momentarily and then released, the grid of V405B is momentarily brought to zero volt. C420 is discharged and V405B conducts. When the identification control is released, C420 starts charging toward -15 volts. Conduction of V405B is maintained for a time, dependent upon the time constant of C420, R435, and delay time adjust potentiometer R434. R436 is a small isolating resistor to limit the discharge current of C420 when the identification switch is grounded. The discharge time constant of C420 is approximately 40 milliseconds allowing C420 to become completely discharged during the time the identification switch is turned on and off.

7. MODULATOR MODULE.

The modulator grid pulse obtained from the encoder is applied to the control grid of modulator tube V301 through P302-2. See figure 25. Eleven hundred-volt negative pulses are developed across the primary of modulation transformer T301, inverted in the secondary, and applied as positive pulses to the transmitter oscillator in the r-f module via J312, P112, and J113. A small voltage is obtained across R304 as a result of transmitter pulse current and is used to monitor transmitter pulsing.

The plate of V301 receives approximately 2200 volts from a high-voltage supply which consists of two selenium rectifiers operating in a full-wave voltage doubler circuit. The rectifiers are supplied



Modulator Module, Simplified Schematic Diagram
Figure 25

with power from plate transformer T302. Current flow on one half-cycle charges C301A. On the next half-cycle, C301B is charged, and the voltage on C301A doubled. The doubled voltage from C301A is applied to T301. Resistors R306 through R309 discharge C301A and C301B after power is turned off. One quarter of the high voltage can be measured at J302.

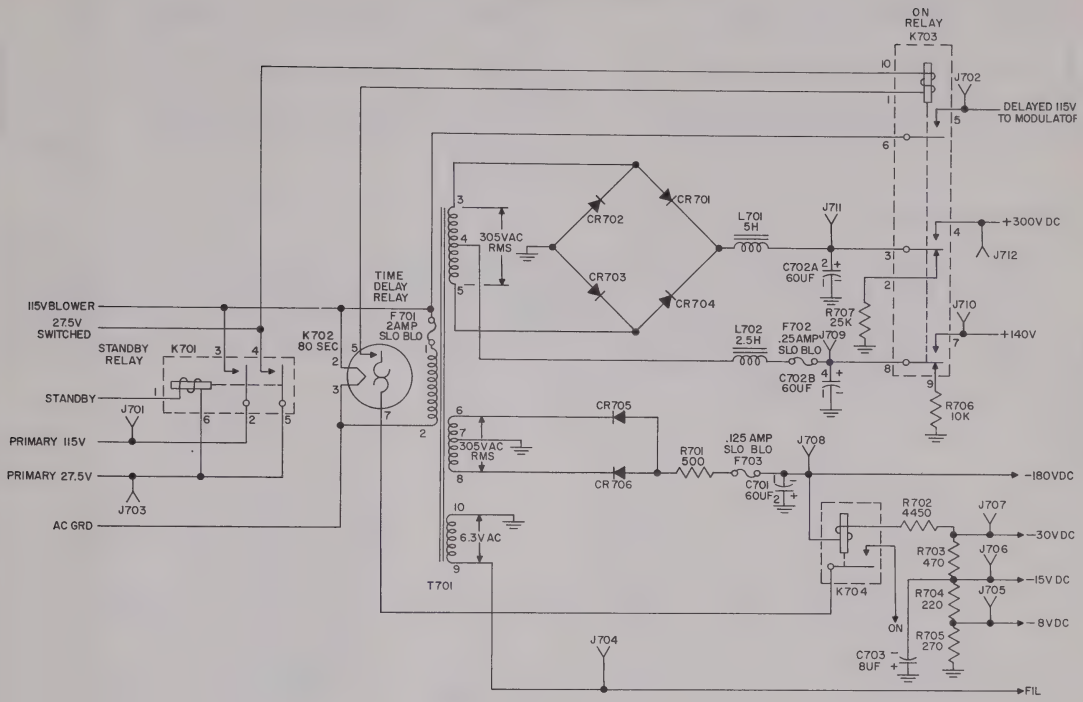
The high-voltage supply is fused by F301. R311 is a grid return used to bias off V301 when the encoder module is removed from the main chassis. Potentiometer R302 is used to adjust the transmitter power output. As the transmitter tube ages, the power output goes down. R302 may be adjusted, as required, to bring the power output up to the proper level.

8. POWER SUPPLY MODULE.

The power supply module contains three major d-c supplies, namely +300, +140, and -180 volts. In addition, a-c filament voltage and bias voltages of -30.0, -15, and -8 volts are furnished. See figure 26.

When the function switch on the control unit is set to standby (STBY), relay K701 energizes immediately. At this time, the 115-volt supply is placed across time delay K702; primary 115 volts, 300 to 1000 cps is applied to power transformer T701; bias voltages are applied to all circuits of the 621A-2, a-c filament voltage is applied to all tube filaments, and the 115-volt 300- to 1000-cps supply is connected to the blower.

About 80 seconds after primary power is applied by K701, the contacts of time-delay relay K702 close. K702 is in series with K703 and the ON and LO SENS positions on the control panel. If the 621A-2 is set to ON or LO SENS, K702 allows R703 to be energized. K703 applies 115 volts a-c to the high-voltage supply in the modulator as well as +140 volts d-c and +300 volts d-c to



Power Supply Module, Simplified Schematic Diagram
Figure 26

the 621A-2. If the 621A-2 is placed immediately to ON or LO SENS, no positive d-c power is provided until 80 seconds have elapsed After the initial 80 seconds, the 621A-2 may be turned from ON to LO SENS to standby (STBY) and back instantaneously. The secondary windings of power transformer T701 supply the +300-volt, +140-volt, and -180-volt rectifiers. The +300-volt and -140-volt supplies use a common single-phase rectifier with diodes CR701, CR702, CR703, and CR704 arranged in a bridge for the +300-volt supply and diodes CR702 and CR703 used as a center-tap, full-wave rectifier for the +140-volt supply. Both supplies are choke input with the F701 as a fuse for both supplies. F702 fuses the +140-volt supply. R706 and R707 are +140-volt and +300-volt supply load resistors during standby.

The -180-volt supply is a center-tap, full-wave, single-phase, capacitor input type using diodes CR705 and CR706. Bias supplies are obtained from the bleeder R702 through R705. All rectifiers are silicon.

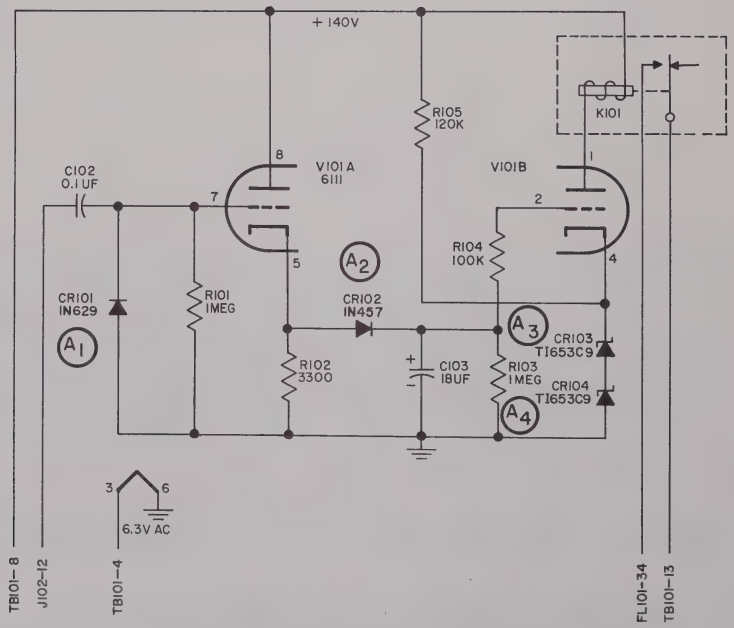
The following voltages can be monitored at appropriate test points:

J701	Primary 115-volt a-c 300 to 1000 cps	J704	6.3-volt a-c filament
J702	Delayed 115-volt a-c to modulator	J705	-8.0-volt bias voltage
J703	Primary +27.5-volt d-c	J706	+15.0-volt bias voltage

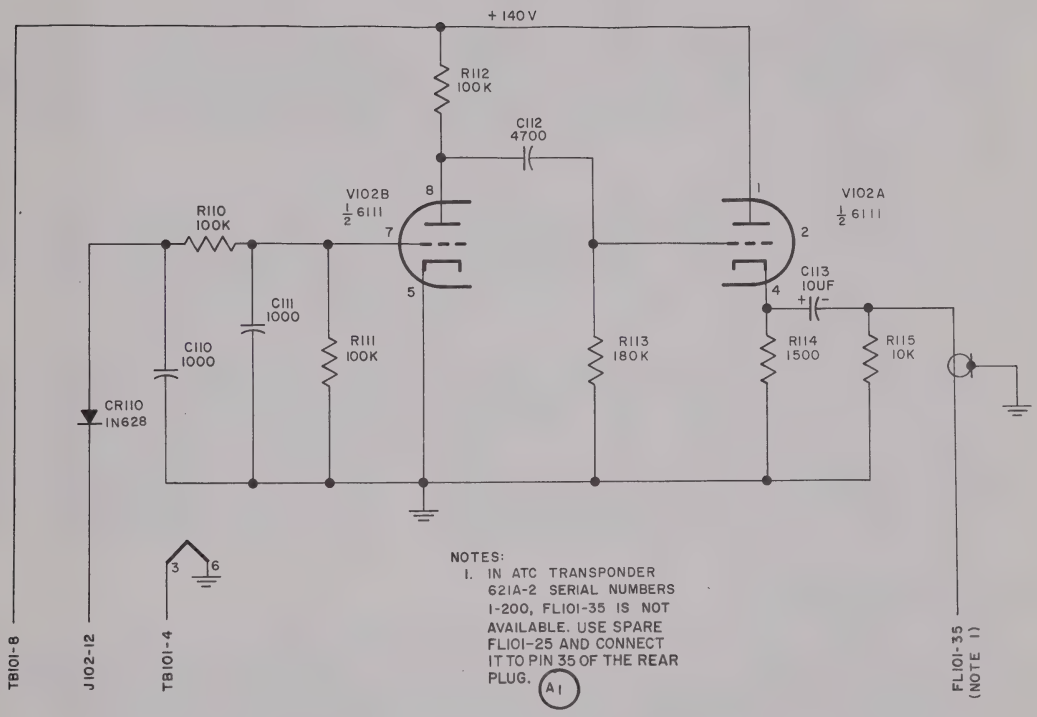
J707	-30.0-volt bias voltage	J710	+140 volts (after switch)
J708	-180-volt supply voltage	J711	+300 volts (before switch)
J709	+140 volts (before switch)	J712	+300 volts (after switch)

9. MAIN CHASSIS.

The chassis wiring diagram shows the interconnecting wiring between modules, blower, front panel connectors, and rear connector. A ferrite filter on each wire on the rear connector serves as a line filter except for pins 29, 30, and 31 which have an individual LC type radio interference filter. The chassis assembly may also contain an optional visual or audio monitor circuit. These circuits are discussed in paragraphs 10 and 11.



Visual Monitor Circuit, Schematic Diagram
Figure 27



Audio Monitor Circuit, Schematic Diagram
Figure 28

10. VISUAL MONITOR CIRCUIT.

The visual monitor circuit, which is optional, provides 27.5 volts d-c to pin 34 on the rear plug of the 621A-2 when the unit is being interrogated by one or more ground interrogators with a minimum interrogation rate of 175 per second. Components for the circuit, Collins part number 544-9365-00, are available from the manufacturer or may be installed as a custom installation. A schematic diagram of the visual monitor circuit is furnished in figure 27.

When the modulator tube, V301, of the 621A-2 is triggered, a pulse with an amplitude of approximately -40 volts is developed across R304. This pulse, which may be monitored at test point J303, is routed from J102-12 to C102 of the visual monitor circuit and clamped by diode CR101 to charge C102. When the pulse ends, the capacitor has a positive charge which must be discharged through R101. The time constant of R101 and C102 is 0.1 second, and during this time, V101A is conducting.

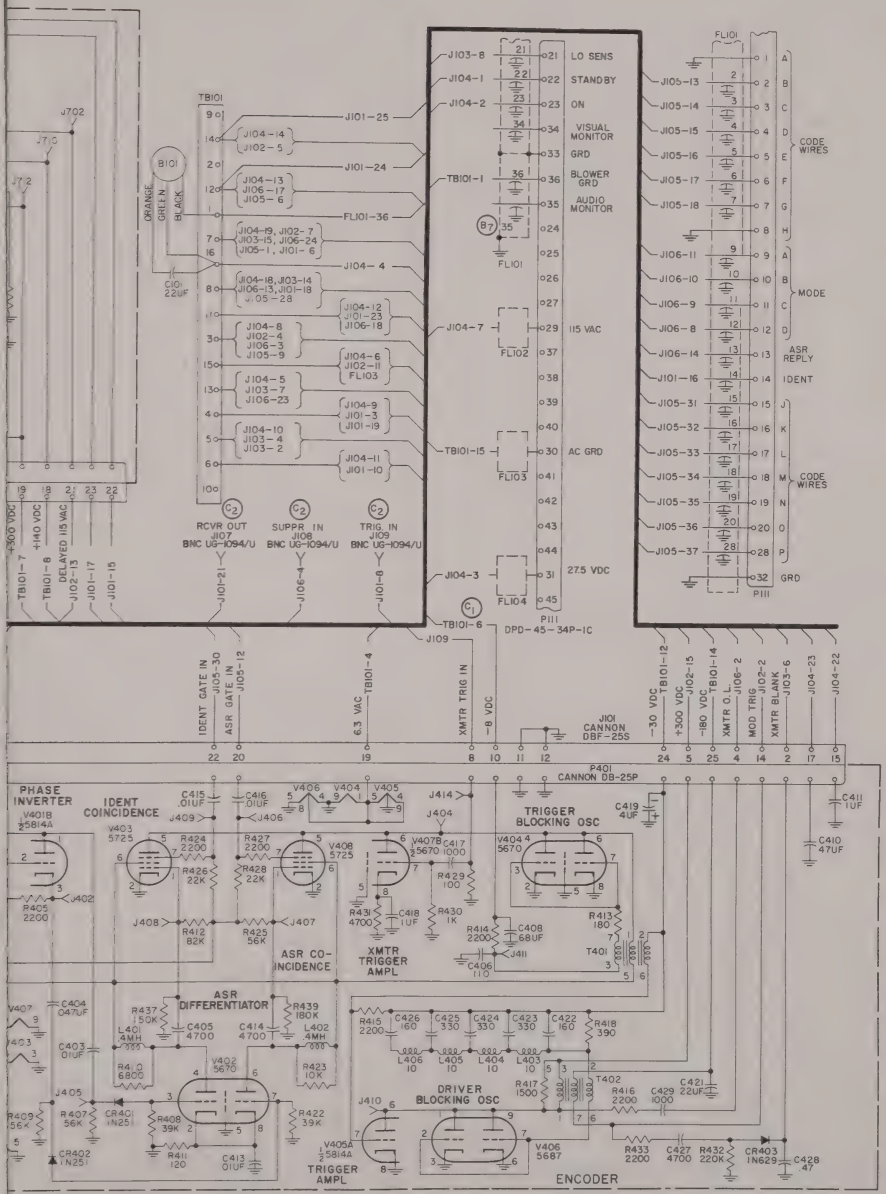
The voltage developed across R102, when V101A is conducting, is coupled through CR102 to charge C103. When C103 is charged to the proper level to overcome the cathode bias on V101B, the tube conducts and closes relay K101. Relay K101 in turn applies 28 volts to the visual monitor indicator. The time constant of C103 and R103 is large enough so the visual monitor circuit indicator will remain lighted between sweeps of the rotating ground antenna.

Access holes are provided in the main chassis of ATC Transponders 621A-2, serial numbers 578 and above, so a test prod may be placed on various terminals of the visual monitor board to trouble shoot and test the circuit without having to disassemble the 621A-2. These holes, which are located beneath the encoder module, are numbered on the chassis to correspond to the numbers on the visual monitor board. The location of each of these terminals in the schematic diagram of the visual monitor circuit is described by a keyed schematic diagram of the visual monitor circuit located in the Trouble-Shooting section of the Overhaul Manual, Collins part number 520-5925-00, ATC Transponder 621A-2.

11. AUDIO MONITOR CIRCUIT.

An audio monitor circuit, which is optional, supplies 50 milliwatts across 500 ohms to pin 35 of the rear connector of the 621A-2. Components for the circuit, Collins part number 546-3538-004, are available from the manufacturer or may be installed as a custom modification at the factory. Figure 28 is a schematic diagram of the audio monitor circuit.

When the modulator tube, V301, of the 621A-2 is triggered, a pulse with an amplitude of approximately -40 volts is developed across R304. This pulse, which may be monitored at test point J303, is routed from J102-12 through CR110 into a pulse stretching network consisting of C110, R110, and C111. The longer pulse is then applied to the grid (pin 7) of V102B, amplified, and then coupled via C112 to the grid of V102A. V102A operates as a cathode follower. Audio output is taken from the cathode (pin 4) of V102A through C113. R115 is a load resistor, R114 a cathode resistor, R112 a plate load resistor, and R113 a bias resistor.

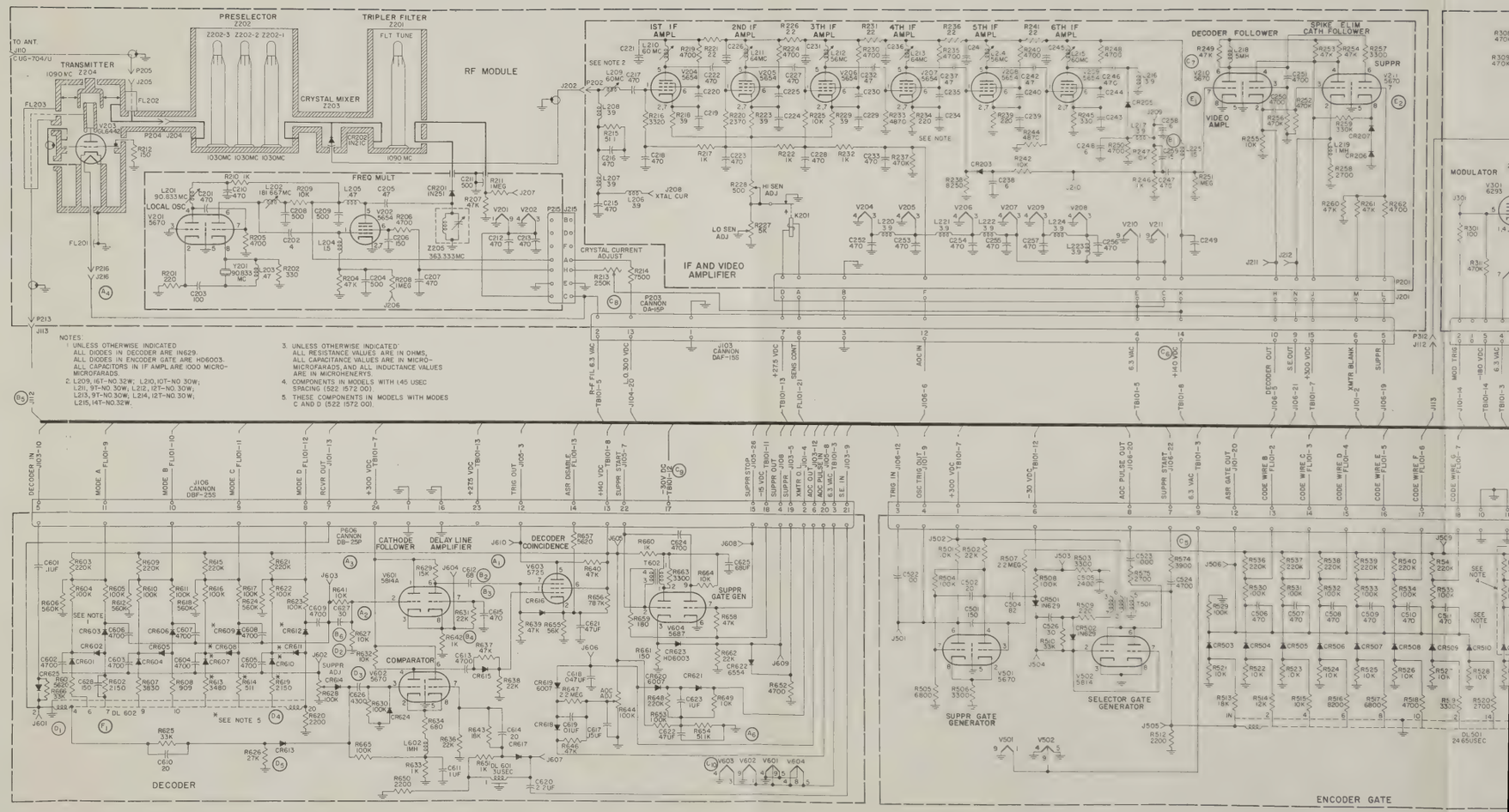


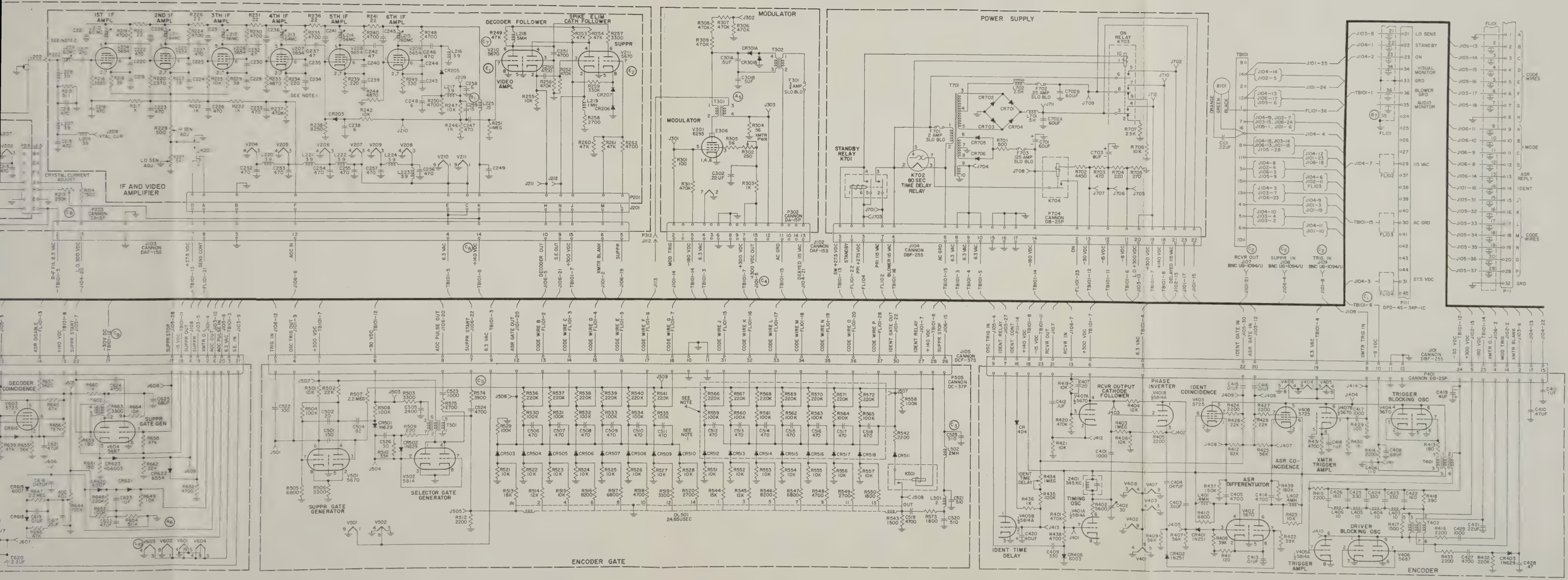
ATC Transponder 621A-2, Over-all Schematic Diagram
Figure 29

REVISION REFERENCE

The following descriptions identify the changes to the over-all schematic diagram of ATC Transponder 621A-2.

REVISION INDEX CODE	REVISION DESCRIPTION	SERIAL NUMBER EFFECTIVITY
A_1	Test Point J604 relocated	315 and above
A_2	R627 reduced to 10K	315 and above
A_3	R641 reduced to 10K	315 and above
A_4	Add P216 and J216	All models
A_5	Remove ground symbol on T301-3	All models
A_6	Changed R654 from 44.2K to 51.1K	All models
B_1	Add capacitor C259	331, 334, 335, 336, 364, 368, 374, 378, 379, 382, and above
B_2	Changed C612 from 100 uuf to 68 uuf	326, 328, 330, 331, 332, 334, 336, and above
B_3	Changed R642 to R631	All models
B_4	Changed R641 to R642 (resistor from V601-8 to ground)	All models
B_5	Changed label of wire from J113 from "P112" to "J112"	All models
B_6	Deleted C627	326, 328, 329, 330, 331, 332, 334, 336, and above
B_7	Added FL101-35	201 and above
C_1	Changed label of wire from J101-10 from TB101-14 to TB101-6	Add models
C_2	Changed the plug types of J107, J108, and J109 from BNC UG-109/U to BNC UG-1094/U	Add models
C_3	Changed C522 to C525	All models
C_4	Changed the label of wire from J102-15 from TB101-13 to J101-5	All models
C_5	Changed R579 to R574	All models
C_6	Changed the label of wire from J103-14 from +140 VAC to +140 VDC	All models
C_7	Changed R254 to R249	All models
C_8	Delete pin J103-14. Connect the center tap of R213 to J201-K	All models
C_9	Added wire from J106-17 to TB101-12	All models
C_{10}	Changed the filament designation V605 to V603	All models
D_1	Added CR625 and R666 Added C628	579 and above 513, 530, 539, 557, 561, 564, 568, 571, 573, 578, and above
D_2	Added C627	513, 530, 539, 557, 561, 564, 568, 571, 573, 577, and above
D_3	Changed C626 from 470 to 4300	579 and above
D_4	Changed R613 from 4640 to 3480. Changed R614 from 1 K to 511. Changed R619 from 1870 to 2150	All models
D_5	Changed R626 from 22K to 27K	579 and above
E_1	Interchanged the pin numbers of V210.	All models
E_2	Interchanged the pin numbers of V211	All models
F_1	Changed the lead of C628 to tap 7 on DL602.	All models





ATC Transponder 621A-2, Over-all Schematic Diagram
Figure 29

ATC TRANSPONDER 621A-2 - TROUBLE SHOOTING

1. GENERAL.

The following procedures are to be used by line maintenance personnel in locating system difficulty while the unit is installed in the aircraft. The complete ATC transponder system is composed of ATC Transponder 621A-2 and the associated shockmount, a control unit, antenna, and various power supplies and interconnecting cables. Trouble-shooting procedures should be such that the difficulty is isolated to one of these components. Once the defective component is identified, it is replaced with one known to be in good operating condition.

2. PROCEDURES.

A. Check the Shockmount.

(1) Visually check the shockmount in a normal, loaded position. Check for noticeable sagging in any of the resilient mounts.

(2) Depress one end of the shockmount from a normal, loaded position until the resilient mounts are at a bottom position. The resilient mounts should permit a minimum travel of one-sixteenth inch. Check the other end of the shockmount.

(3) Lift up one end of the shockmount until the resilient mounts are at an upward position. The resilient mounts should permit a minimum travel of one-sixteenth inch. Check the other end of the shockmount.

(4) If the shockmount fails to respond properly to these tests, replace it.

B. Interconnecting Wiring.

Figures 2, 3, and 4 present the installations possible with either single or dual installations. Interconnecting wiring tests should be made with reference to the installation diagram applicable to the specific installation.

C. System Trouble Shooting.

(1) Perform the test described in the testing section of this manual using Test Set 476X-1. Failure to obtain information on any of the three reply indicators of the 476X-1 indicates that the 621A-2 or antenna system is defective.

(2) Isolation of the defect to the 621A-2 or antenna system can be accomplished by carrying Test Set 476X-1 into the aircraft and connecting it directly to the 621A-2. If proper operation is then obtained, the trouble is probably in the antenna system. Complete information about Test Set 476X-1 is contained in the instruction book, Collins part number 523 0008 00.

ATC TRANSPONDER 621A-2 - SERVICING

1. GENERAL.

ATC Transponder 621A-2 requires no servicing other than periodic tests to establish that the system is in proper operating condition. Testing procedures are given in the testing section of this manual.

ATC TRANSPONDER 621A-2 - REMOVAL/INSTALLATION

1. GENERAL.

This section describes procedures to be used in removing and reinstalling components of the ATC Transponder 621A-2 system.

2. REMOVE ATC TRANSPONDER 621A-2.

A. Disconnect all electrical connections to the three BNC and type-C front panel connectors. Identify the disconnected leads.

B. Loosen and disengage the hold-down clamps of the shockmount.

C. Rotate the extractor wing nut until the 621A-2 is disengaged from the rear connector of the shockmount.

NOTE: When removing the 621A-2 from its shockmount by using the extractor mechanism, be sure that the hold-down clamps are disengaged before rotating the extractor wing nut.

3. INSTALL ATC TRANSPONDER 621A-2.

A. Place the 621A-2 on the shockmount, and push toward the rear, making sure that the plug on the 621A-2 is inserted properly in the shockmount receptacle.

B. Rotate the extractor wing nut clockwise until the rear connector of the 621A-2 is engaged fully with the rear connector of the shockmount. Do not overtighten the extractor wing nut. The extractor mechanism is designed to aid in removing and replacing the 621A-2 from its shockmount and not a means of holding the 621A-2 in place.

C. Engage and tighten the locking mechanisms of the shockmount.

4. REMOVE SHOCKMOUNT.

A. Disconnect the ground straps.

B. Remove the sixteen no. 10-32 screws, lock washers, and nuts which fasten the shockmount to the radio shelf.

C. Remove the electrical connector from the rear of the shockmount.

5. INSTALL SHOCKMOUNT.

A. Reconnect the electrical connector to the rear of the shockmount.

B. Fasten the shockmount to the radio shelf with sixteen no. 10-32 screws, lock washers and nuts.

C. Connect the ground straps under each shockmount foot making sure that a good ground contact exists.

6. ANTENNA AND CONTROL UNIT.

Instructions for removing and reinstalling the antenna and control unit will vary as to the types of units used. Outline and mounting dimensions for the control unit and antenna are furnished in the Installation Manual.

ATC TRANSPONDER 621A-2 - ADJUSTMENT/TEST

1. GENERAL.

This section describes tests which may be made upon ATC Transponder 621A-2 while the system is installed in the aircraft.

2. ADJUSTMENTS.

No adjustments should be attempted while the unit is installed in the aircraft. Adjustments which may be made when the equipment has been removed from the aircraft are described in the Overhaul Manual.

3. TESTS.

A. Test Equipment Required.

Transponder Test Set 476X-1, Collins part number 522 1791 00, is required to perform tests upon the 621A-2 installation while installed in the aircraft.

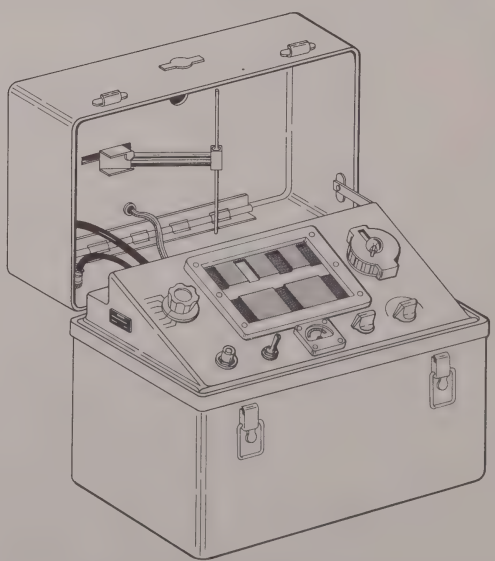
(1) Test Set 476X-1.

Test Set 476X-1 provides portable test facilities for performing rapid and convenient flight line checks of ATC Transponder installations. The test equipment simulates the ground beacon by interrogating the transponder and analyzing the reply pulse train. Tests may be accomplished by either radiation or direct connection methods. This test set is designed to permit one man to perform complete tests of transponder receiver sensitivity, transmitter power output, transmitter frequency, reply pulse coding, reply pulse spacing, operation of identification function, and operation on all interrogation modes.

Special automatic programming and suitable indicators are provided to allow tests to be conducted by a single operator. Self-test features permit a rapid check of the ramp tester before use. The unit is enclosed in a rugged, weather-proof case for operation under all flight line conditions. Some of the outstanding features of the 476X-1 are as follows:

(a) One Man Operation.

Special flag-type indicators and automatic cycling circuitry permit testing by the operator from the cockpit.



Transponder Test Set 476X-1, Over-all View
Figure 501

(b) Go/No-Go Indications.

Indicators that are easily visible from the cockpit at distances of 75 feet provide the operator with positive go/no-go information.

(c) Self-Test.

A built-in self-test feature permits a rapid check of the operation of the test equipment.

(d) Testing Provisions.

The test equipment will check all reply pulse codes, pulse spacing, transmitter frequency, transmitter power output, receiver sensitivity, and identification circuit operation. Operation on two interrogation modes is provided with provisions for adding modes C and D when assigned.

(e) Built-In Antenna.

A built-in vertically polarized directional antenna is provided to reduce reflection errors and minimize undesired interrogation of other transponders in the test area.

(f) Transistorized.

Semiconductors are employed to provide increased reliability, low battery drain and to reduce warm-up time.

(g) Self-Contained Power Source.

Unit is battery operated with a built-in trickle charger.

(h) Portability.

The self-contained test equipment can be hand carried to any location. The overall dimensions are 13-1/4 by 12-3/8 by 9-3/16 inches and the weight is approximately 29.5 pounds.

B. Test Procedure.

Complete instructions for operating Test Set 476X-1 are contained with the equipment and furnished in instruction book, Collins part number 523 0008 00.

The operator may place the test equipment in any convenient position visible from the cockpit. The test equipment is then turned on and rapidly checked before use by setting the mode selector control to the self-test position and noting proper response of the indicators. The test level control is adjusted to the proper position determined by the distance between the ramp tester and the aircraft antenna. The code selector is set to any one of 64 code combinations, and the mode selector is set for the desired mode of operation. The operator then enters the cockpit and turns on the transponder. The mode selector on the transponder control box is set to the mode indicated on the ramp tester and the code selector is adjusted for the same code previously set on the test equipment. Proper operation is indicated by the actuation of the code indicator on the ramp tester. The complement of the desired code is then selected on the transponder control box, and proper operation is shown by the actuation of the complement code indicator. These two tests involving a selected code and its complement, i.e., code 25 and 52, provide a complete check on the presence of all desired reply

pulses as well as check for the presence of any undesired pulses. The mode selector is then reset to the other modes as programmed and indicated by the ramp tester, and the tests are repeated to check all modes of interrogation. The identification button can be depressed at any time, and operation of the identification indicator of the ramp tester will signify proper operation.

If the transponder and the antenna system are not functioning properly, the fault may be further isolated by direct connection to the transponder. Proper operation when directly connected would then indicate an antenna fault.

ATC TRANSPONDER 621A-2 - INSPECTION CHECK

1. GENERAL.

This section describes inspections and checks to be performed upon the equipment while it is installed in the aircraft.

2. PROCEDURE.

A. Check the shockmount in a normal loaded position. Check for any noticeable sagging in any of the resilient mounts.

B. Check the equipment for damage to the finish.

C. Check all cabling to the equipment for signs of wear, broken wires, or bad connections. Check that all cable connectors are secure. Check that all ground straps are secure.

D. Check that the equipment is securely fastened to the shockmount and that the tightening nuts on the shockmount are safety wired.

ATC TRANSPONDER 621A-2 - CLEANING/PAINTING

1. GENERAL.

No cleaning or painting is required or recommended while the equipment is installed in the aircraft. Approved cleaning and painting procedures should be performed when the equipment is removed from the aircraft as described in the Overhaul Manual.

ATC TRANSPONDER 621A-2 - APPROVED REPAIRS

1. GENERAL.

No repairs are to be attempted which require the removal of the dust cover of the 621A-2 while the equipment is installed in the aircraft. Complete overhaul instructions are furnished in the Overhaul Manual.

WARNING: ANY ATTEMPTED REPAIRS OF THE 621A-2 WITHOUT THE REQUIRED TEST FACILITIES SPECIFIED IN THE OVERHAUL MANUAL MAY RESULT IN MISALIGNMENT OF THE EQUIPMENT WITH RESULTING LOSS OF ACCURACY AND RELIABILITY.

ELECTRICAL WIRE CODE

EXAMPLES

UNSHIELDED WIRE, MIL TYPE B #22 AWG, WHITE WITH RED AND GREEN TRACERS:

D	A	9	25	—	4-1/4
Type of Wire	Size of Wire	Color of Body	Color of Tracers		Length of Wire in Inches (Includes Stripping & Tinning)

SHIELDED WIRE (SINGLE), MIL TYPE C, #15 AWG, WHITE WITH RED AND GREEN TRACERS:

R	D	S	9	25	—	4-1/4
Type of Wire	Size of Wire	Shielded	Color of Body	Color of Tracers		Length of Wire in Inches (Includes Stripping & Tinning)

SHIELDED WIRE (MULTIPLE), MIL TYPE B, #22 AWG, WHITE, AND WHITE WITH RED TRACER:

D	A	S	(9)	(92)	—	4-1/4
Type of Wire	Size of Wire	Shielded	First Conductor	Second Conductor		Length of Wire in Inches (Includes Stripping & Tinning)

TYPE OF WIRE CODE		
LETTER	TYPE OF WIRE	FAMILY USUALLY FOUND IN
A	Cotton Braid Over Plastic (Formerly AN-J-C-48)	440 Plain 443 Shielded
B	Busbar, Round Tinned	421
C	MIL-W-16878 Type B (#20 and Larger) (600 Volts)	439
D	Miniature Wire, MIL-W-16878 Type B (#22 & Smaller)	439-7000 Series
E		
F	Extra Flexible Varnished Cambric	423
G		
H	Kel-F (Monochloro-trifluoroethylene)	422
J		
K	Neon Sign Cable (15,000 Volts)	423 0004 00
L	Silicone	425 0942 00
M		
N	Single Conductor Stranded (Not Rubber Covered)	422
P	Single Conductor Stranded (Rubber Covered)	423
Q		
R	MIL-W-16878 Type C (1000 Volts)	439 1000 Series
T	Teflon, MIL-W-16878 Type E (600 Volts)	439 4000 Series
V	MIL-W-16878 Type D (3000 Volts)	439 3000 Series
W	Teflon, MIL-W-16878 Type EE (1000 Volts)	439 0000 Series
X		
Y		
Z	Acetate Yarn Telephone Type	428

SIZE OF WIRE CODE	
LETTER	SIZE
A	#22 AWG
B	#20
C	#18
D	#16
E	#14
F	#12
G	#10
H	#8
J	#6
K	#4
L	#2
M	#1
N	#0
P	#00
Q	#000
R	#0000
T	#28
V	#26
W	#24
X	#19
Y	#30
Z	

COLOR CODE	
NUMBER OR LETTER	COLOR
0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray (Slate)
9	White
a	Clear
b	Tan
c	Pink
d	Maroon
e	Light Green
f	Light Blue

COLLINS RADIO COMPANY